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The geology and botany of the upper penisula experiment station

Charles F. Wheeler

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See p. 17.

BULLETIN 186 DECEMBER, 1900

MICHIGAN

STATE AGRICULTURAL COLLEGE

EXPERIMENT STATION

FIRST REPORT OF THE

UPPER PENINSULA EXPERIMENT STATION

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AGRICULTURAL COLLEGE, MICHIGAN
1901

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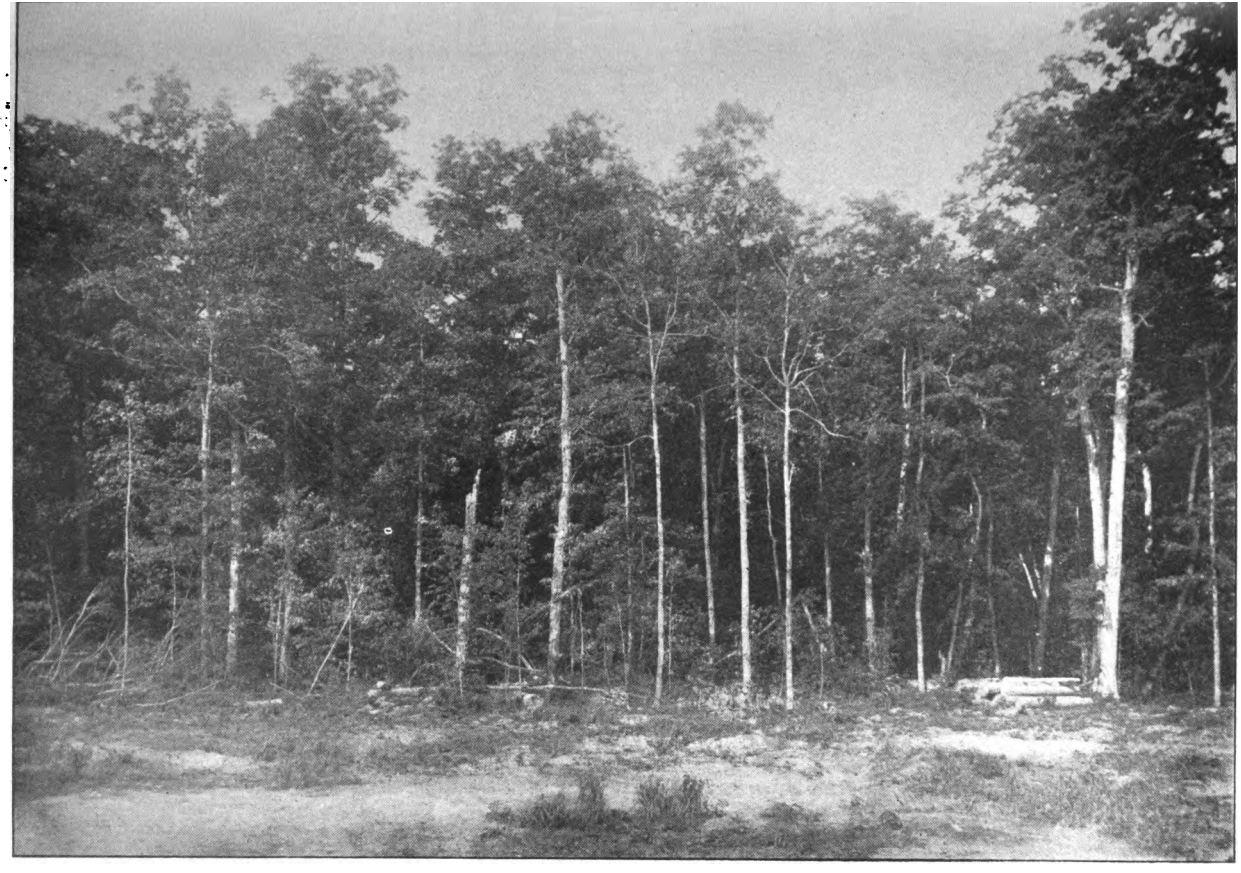

The Experiment Station as it appeared May 1, 1899, heavily timbered with maple.

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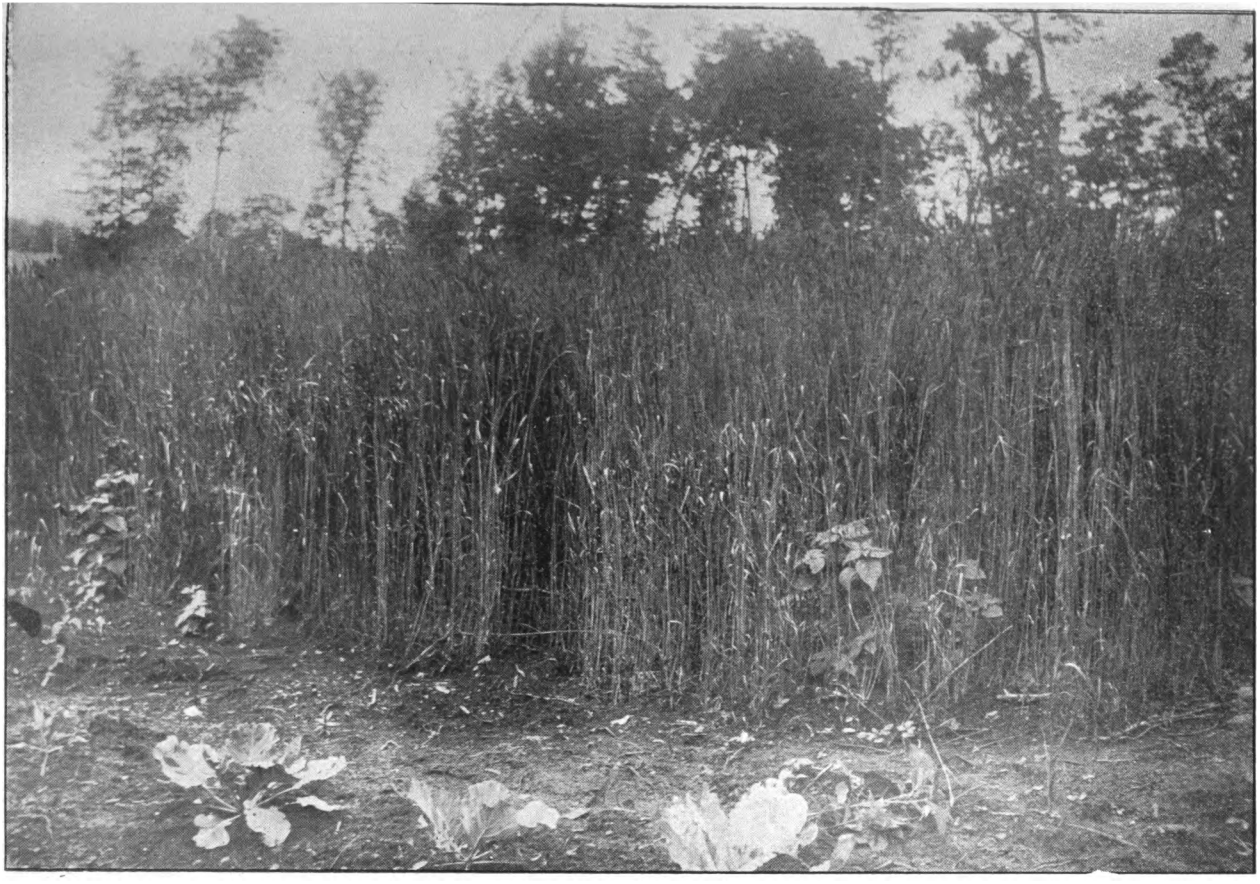

Wellman's Fife Spring Wheat, sown May 17, harvested September 7, yield 29 bushels per acre, 5 feet 4 inches tall.

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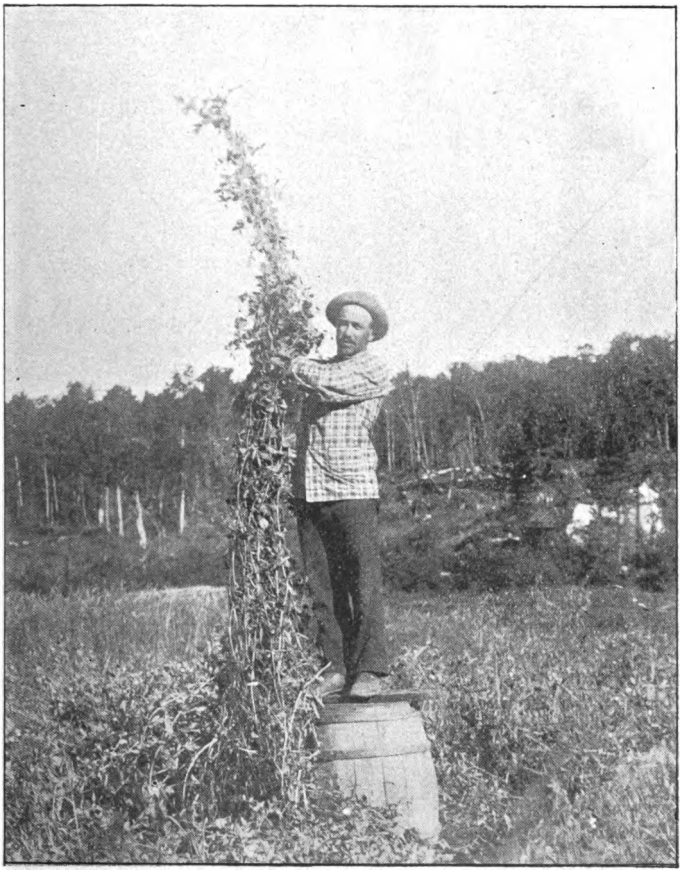

Improved Russian Blue Field Peas, sown May 17, harvested September 5. yield 42 bushels per acre, vines 10 feet tall.

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Oats, Cabbage, Celery.

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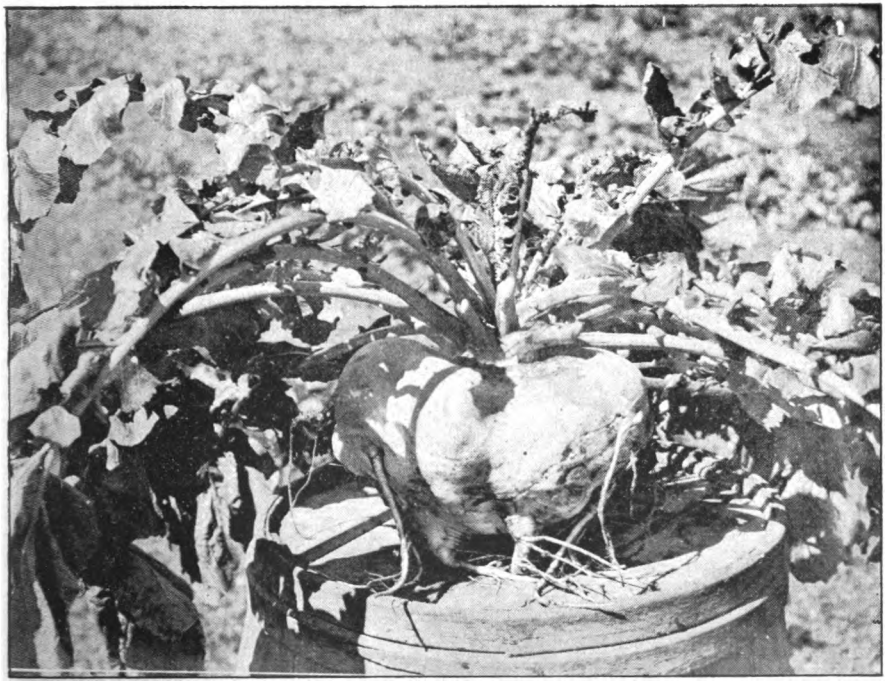

Specimen Turnip, yield 785 bushels per acre.

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Early Butler Yellow Dent Corn. Planted June 7, height 10 feet, yield 78 bushels per acre.

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Rape sown June 16, height 36 inches, September 20.

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Japanese Millet, sown June 18, height when harvested 6 feet 8 inches, yield 13 tons per acre.

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General view of the cleared portions of the Station grounds.

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Fruit trees with rows of vegetables between.

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Black Spruces attacked by the Dwarf Mistletoe or "Witch's Broom."

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Healthy Black Spruces.

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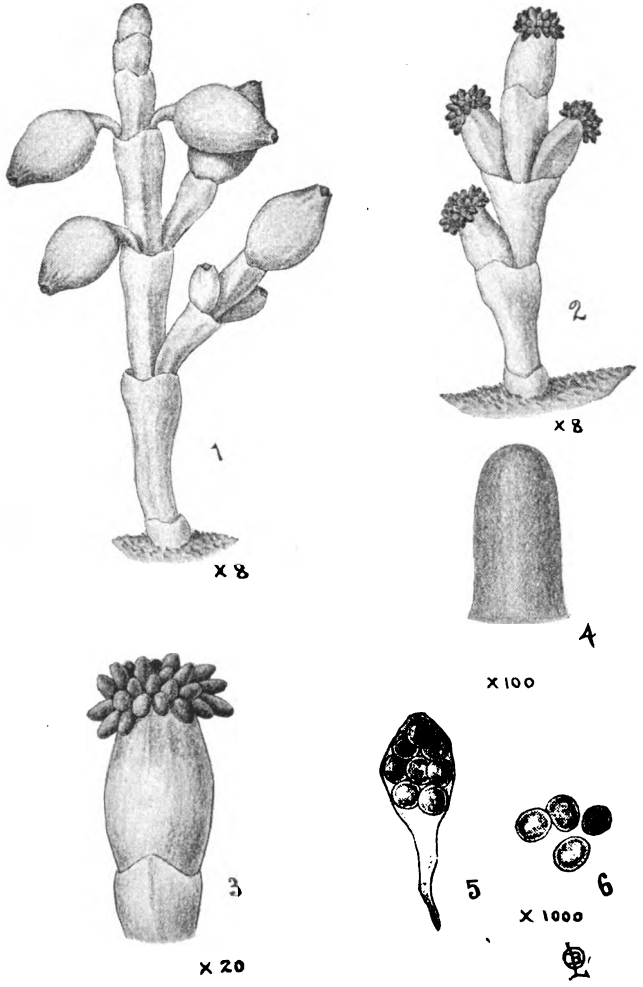

The Dwarf Mistletoe (Arceuthobium pusillum, Peck), attacked by the fungus (Wallrothiella arceuthobii, Peck.) 1—The Mistletoe free from the fungus. 2—Mistletoe attacked by fungus. 3—A single fruit of the Mistletoe enlarged, showing the disease. 4—A single fruit of the fungus enlarged. 5—A sporecase showing cluster of eight spores. 6—A group of spores highly magnified.

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Diseased branches of the Black Spruce.

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An excellent edible Mushroom.

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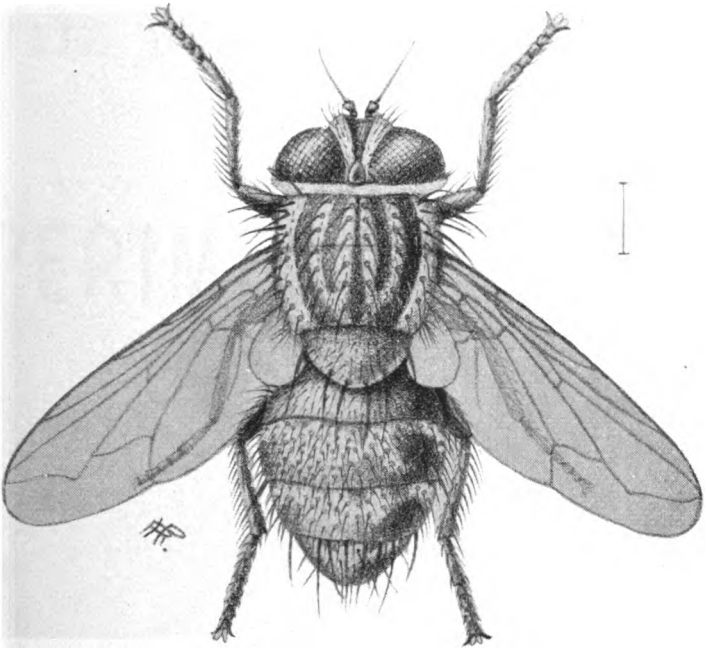

Potato-beetle parasite (Phorocera doryphorae), original.

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ULLETIN 186 DECEMBER, 1900

MICHIGAN

STATE AGRICULTURAL COLLEGE

EXPERIMENT STATION

UPPER PENINSULA EXPERIMENT STATION

AGRICULTURAL COLLEGE, MICHIGAN
1900.

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The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Secretary, Agricultural College, Michigan.

MICHIGAN AGRICULTURAL EXPERIMENT STATION

Postoffice and Telegraph Address, - - - Agricultural College, Mich.
Railroad and Express Address, - - - Lansing, Mich.

A DEPARTMENT OF THE STATE AGRICULTURAL COLLEGE, AND, WITH IT, CONTROLLED BY THE

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ROBERT C. KEDZIE, L. L D., - - Chemist
ARTHUR C. BIRD, B. S., M. Agr., Secretary and Treasurer.

ADVISORY AND ASSISTANT STAFF

HERBERT W. MUMFORD, B. S., Experimenter with Live Stock.
M. L. DEAN, - - Assistant in Horticulture
L. H. VAN WORMER, B. S., Assistant in Chemistry
G. A. WATERMAN, V. S., Consulting Veterinarian
R. H. PETTIT, B. S. A., - - - Entomologist
CHAS. F. WHEELER, M. S., - Consulting Botanist
MRS. L. E. LANDON, - - - - Librarian
S. H. FULTON, B. S., South Haven, in charge of Sub-Station.
LEO M. GEISMAR, Chatham, in charge U. P. Station.

SUB-STATIONS.

Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded.
Chatham, Alger County, 160 acres deeded.

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BULLETIN 186 DECEMBER, 1900

REPORT

OF THE

UPPER PENINSULA EXPERIMENT STATION

FOR THE YEAR 1900

President J. L. Snyder:

I have the honor to submit herewith, the first report of the work accomplished at the Upper Peninsula Experiment Station, to be printed as No. 186 of Experiment Station bulletins. This report includes, first an introductory article giving the law establishing the Station, and its history to date; second a report of the work done at the Station, by Leo M. Geismar, the Superintendent; third, a report on the geology and botany of the Station by C. F. Wheeler, the Station Botanist, and, finally, a report as to the insect and animal life found in the vicinity of the Station by R. H. Pettit, the Entomologist of the Station.

Yours respectfully,

CLINTON D. SMITH.

Director.

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THE UPPER PENINSULA EXPERIMENT STATION.

CLINTON D. SMITH, DIRECTOR.

The State Legislature at its regular session, beginning January, 1899, passed an act appropriating $5,000 for the establishment and maintenance of an Experiment Station in the Upper Peninsula. A copy of that act follows:

The People of the State of Michigan enact:

Section 1. That the members of the official board of the Agricultural College of this State shall ex-officio constitute a board of locating and building commissioners for the purpose of selecting a site and erecting the necessary buildings thereon for a State Agricultural and Horticultural Experiment Station in the Upper Peninsula.

Sec. 2. The said board of commissioners may receive by donation within six months from and after the approval of this act in some portion of the Upper Peninsula which seems to them most suitable for the above mentioned purpose a tract of land containing not less than eighty acres.

Sec. 3. That the deed for such site shall be duly executed to the people of this State and delivered to the Auditor General.

Sec. 4. If, after the selection of such site, it be found necessary, the said board shall have power and it shall be their duty to procure and adopt plans, specifications and estimates and to erect suitable buildings thereon and the said board shall carry on such experiments pertaining to agriculture and horticulture as in their judgment will be most beneficial to the agricultural interests of the Upper Peninsula, and they shall have full control of the management of said Experiment Station: Provided, however, That the entire cost of said buildings shall not exceed the sum of $2,500.

Sec. 5. Upon the adoption of plans and specifications by said board, they shall advertise for a time not less than four weeks in such papers as they may select in said Upper Peninsula for proposals for constructing said buildings in accordance with the plans and specifications. All contracts for labor or materials to be used in the erection and construction of the buildings provided for by this act requiring an expenditure of more than $300 shall be let to the lowest bidder or bidders, the advertisement thus provided for to specify the time and place where the bids or proposals made in pursuance thereof shall be opened; all bids or proposals thus made shall be sealed and shall not be opened at any time or place other than that designated in the advertisement; all or any bids or proposals received by said board may be by them rejected and whether accepted or rejected shall after decisions thereon by said board be deposited in the office of the Secretary of State.

Sec. 6. In letting contracts, said board shall not obligate the State to pay to any contractor any money other than that to which said contractor may be justly entitled by reason of labor or materials already

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furnished or supplied, and in no event shall more than seventy-five per cent of the amount called for in any contract be paid to the contractor named therein before the completion of his contract and its acceptance by said board: Provided, That every contractor performing service or work or furnishing materials under this act shall enter into such bonds with sureties for the proper performance of his contract as shall be required by the board of commissioners.

Sec. 7. Each of the members of said board of locating and building commissioners shall be entitled to receive his actual traveling expenses in the discharge of his duties under this act.

Sec. 8. And there is hereby appropriated for the purpose of carrying out the provisions of this act the sum of $5,000 and the same shall be incorporated in the State tax as follows, to wit: For the year 1899, $2,500; for the year 1900, $2,500, and the sums when collected shall be placed by the Auditor General to the credit of said Experiment Station fund and may be drawn by the treasurer of said board upon warrants made by their secretary and approved by the president of said board. And the treasurer above mentioned is hereby required to give his bond to the people of this State in the penal sum of double the amount that is liable to come into his hands under the provisions of this act. The amount of said bond to be determined by said board.

Sec. 9. It shall be the duty of the secretary of said board to render semi-annually to the Auditor General accounts current of all cash transactions and all moneys received, with the proper vouchers, and no money shall be drawn by virtue of this act by said board unless they shall have first filed with the Auditor General an estimate and statement showing the purpose for which money is required, also have made the semi-annual account of all moneys previously drawn.

Late in July, 1899, the State Board of Agriculture, obeying the mandate of this law made a rapid survey of some of the agricultural sections of the Upper Peninsula and chose as the site of the Upper Peninsula Experiment Station the 160 acres constituting the southeast quarter of Sec. 28; range 46 north; 21 west.

This tract lies along the Munising railroad at Chatham, eighteen miles south and west of Munising, in Rock River township, Alger county. It lies eight miles south of Au Train Bay, on the south shore of Lake Superior, and from 250 to 300 feet above its level. The farm is practically surrounded by a large belt of hardwood timber and the climatic conditions are similar to those existing over the major portion of the central section of the Upper Peninsula. Heavy snow covers the ground during the relatively long winters, preventing deep freezing of the soil. The snow lies on the ground continuously during the winter and until late in the spring when the sudden oncoming of the warm weather forces a rapidity of growth in the vegetable world unknown in regions farther south. The summers are hot and moist with no severe drouths. The autumns are long and usually delightful, although in areas surrounded by forests there is always danger of late frosts in the spring and early frosts in the fall, except along the shores of the great lakes. This danger, however, disappears with the removal of the forests.

The soil on the tract selected is far from homogeneous. Near the little creek, which flows east and west through the center of the 160 acres

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and divides the tract into two approximately equal parts, there is an area of black muck, while on the terraces, which rise one above another on either side, the soil is graded into a black sandy loam, containing plenty of lime and of great native fertility. This soil is spread rather thinly over the solid rock. The valley of the stream, which is known by the name of Slap Neck Creek, is approximately sixty-five feet deep, measuring from the surface of the water in the creek to the level of the upper terraces on each side. These terraces are bounded by gentle connecting slopes, all cultivable. The depth of the soil varies from two and one-half to three and one-half feet. The native timber is maple, for the most part, with a few basswood, cedar, wild cherry and elm. The large size of the trees, combined with the denseness of the forest, demonstrates the good quality of the land. The contour of the surface provides ample drainage, except in time of excessive rain falls.

An analysis of the underlying rock made by Dr. R. C. Kedzie, the chemist of the Experiment Station, exhibits the following composition:

Carbonate of lime	32	per cent
Carbonate of magnesium	22	" "
Sand	35	" "
Iron and aluminium oxides	5	" "
Water and undetermined	6	" "
	100	

The upper strata of these rocks are exceedingly soft and friable. The soil is composed of this rock disintegrated in place and mixed with decaying vegetable matter.

The 160 acres of land on which the Station is located was donated to the State by the Munising Railroad Company. This company also agreed to clear, stump and grub the land as needed for experimental purposes and specifically agreed to clear, stump and grub twenty acres prior to May 1, 1900.

After accepting the donation of the land, the State Board of Agriculture confided the planning and execution of experiments to the Director and Council of the Experiment Station, connected with the Agricultural College.

Mr. Leo M. Geismar, then of Reed City, was appointed Superintendent in charge in the early spring of 1900.

Owing to the unusual lateness of the spring, and the superabundance of rain, combined with the scarcity of men in the entire Upper Peninsula, due to the high price of lumber, the work of clearing the land was greatly delayed. It was not until well toward the middle of May that enough land had been cleared to make possible the planting of a single plot. It was then too late to begin tests the results of which would be based on the comparison of yields of adjacent plots. All that could be done was to test the growth and behavior of our common cereals, vegetables and fruits, in that northern climate, select the varieties best adapted to the conditions existing there, and in general determine the basis for future experiments. The selection of varieties of cereals and other field crops was made by Professor J. D. Towar, the Agriculturist of the Station, who imported much of the seed from either northern

Canada or the northern United States introducing not only the varieties suited to northern Michigan, but the strains of those varieties which had been cultivated in the northern climates long enough to become thoroughly acclimated.

A beginning has been made with vegetables, small fruits and tree fruits, the varieties being selected by Professor L. R. Taft, the Horticulturist of the Station, the plants and seeds furnished by him and the work carried forward by Superintendent Geismar.

The Superintendent was greatly handicapped throughout the season, first by an almost continuous downpour of rain, which not only delayed the starting of crops at the proper time in the spring but prevented the cultivation subsequently; second, by the depredations of deer, against which the Station farm was not provided with suitable fencing; third, the difficulty of obtaining help; fourth, and finally, the absence of buildings wherein could be stored either the tools or the yields of the various plots.

During the late summer and fall the last difficulty was remedied by the construction of a suitable house and barn.

A substantial fence has been put around the cleared plots to exclude animals.

A road runs north and south along the east line of the farm. The areas cleared are adjacent to this road. South of the creek, and including part of the muck bed which borders the stream, two acres and a half have been cleared and used for the celery beds and part of the turnips and other vegetables. South of this cleared space, and adjoining it, an area on the first terrace four hundred feet long by two hundred fifty wide has also been cleared and set out with strawberries and other small fruits, and used for vegetable experiments. On this terrace the apple and other fruit trees have been heeled in and some plots of cereals grown.

North of the creek the site for the buildings was located on a terrace some fifty feet higher than the creek and four hundred fifty feet north of it. North of this building site an area of four acres, approximately, was cleared early in the spring, and upon this four acres were carried on the experiments with potatoes, corn and most of the cereals. Additional areas have been cleared north and west of these plots.

It would be manifestly out of place in a report of this kind to go into a detailed description of the agricultural resources of the Upper Peninsula. Of the fifty-eight thousand, nine hundred fifteen square miles constituting the area of the State, approximately two-fifths is included within the boundaries of the broad triangle of the Upper Peninsula. Of this large area no small proportion is first-class farming land, well adapted by soil fertility and climatic conditions to the growing of root crops, small fruits, stone fruits, apples, oats, barley, wheat, the grasses and clover. The proximity of the great mining districts and the lumber camps insures a regular and active market. High prices for agricultural products are certain for many years to come.

The great variety of soils, from the heavy clays and clay loams of Chippewa county, the muck beds and black prairie soils about Rudyard, Newberry and scattered over all parts of the peninsula, to the rich loams

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of Delta and Menominee counties insures a satisfactory farm to the seeker, no matter what his choice of soil may be. A brief statement concerning the soils of the Upper Peninsula, kindly furnished by the State Geologist, A. C. Lane, and included in this bulletin, gives a comprehensive view of the soil conditions obtaining north of the straits.

FIELD CROPS, VEGETABLES AND FRUITS.

UPPER PENINSULA EXPERIMENT STATION.

LEO. M. GEISMAR, SUPERINTENDENT.

The season of 1900, in the central portion of the Upper Peninsula of Michigan, was characterized by an excessive rainfall well distributed through the season, excepting the week beginning August 12. The following table gives the rainfall, beginning Sunday morning in each case, since July 8, when observations were first taken at this Station, until September 30, the end of the growing season:

RAINFALL.

Day of month.	July.	August.	Sept.
1	.....	.00	.00
2	.....	.00	.44
3	.....	.00	.15
4	.....	.00	.00
5	.....	.00	1.55
6	.....	.15	.77
7	.....	.45	.00
8	.02	.98	.00
9	Trace.	.79	.00
10	.12	Trace.	.55
11	.25	.10	2.30
12	Trace.	.00	.00
13	Trace.	.00	.00
14	.39	.00	.00
15	.18	.00	.00
16	.34	.00	1.10
17	.78	.10	.04
18	.00	.00	.00
19	.18	.29	.13
20	.03	.19	.21
21	.00	.00	.15
22	.00	.00	.30
23	.25	.03	.22
24	.00	Trace.	.14
25	.03	.00	.11
26	.00	.00	.17
27	.00	.10	.20
28	.00	.04	.24
29	.60	.00	.06
30	.00	.00	.....
31	.06	.00	.....

Rainfall by weeks.	
July 14	.78
" 21	1.51
" 28	.28
August 4	.66
" 11	2.47
" 18	.00
" 25	.51
September 1	.14
" 8	2.91
" 15	2.85
" 22	1.93
" 29	1.14
Total	15.18

Temperatures have ruled high and autumn frosts have been delayed much later than normal. The following table gives the mean temperatures for the season:

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TABLE OF MEAN TEMPERATURES.

Date.	Range.	Date.	Range.	Date.	Range.
July 8	59.5	August 5	81.5	September 2	68
" 9	59	" 6	74.5	" 3	65
" 10	57.5	" 7	78.5	" 4	62
" 11	*	" 8	79	" 5	68.5
" 12	*	" 9	74.5	" 6	54.5
" 13	*	" 10	80	" 7	50
" 14	*	" 11	70	" 8	59
" 15	65.5	" 12	62	" 9	56
" 16	57	" 13	64.5	" 10	60
" 17	54.5	" 14	71.5	" 11	60
" 18	65.5	" 15	74.5	" 12	60
" 19	64	" 16	74	" 13	58
" 20	57	" 17	71	" 14	47.5
" 21	58	" 18	71	" 15	60
" 22	71.5	" 19	75	" 16	56
" 23	63	" 20	67	" 17	54
" 24	67	" 21	67	" 18	44
" 25	58.5	" 22	63	" 19	54
" 26	53.5	" 23	72	" 20	55.5
" 27	66	" 24	67.5	" 21	51.5
" 28	74	" 25	67	" 22	60
" 29	65.5	" 26	74	" 23	58.5
" 30	63	" 27	76.5	" 24	62
" 31	69.5	" 28	65.5	" 25	70
August 1	68.5	" 29	58.5	" 26	55.5
" 2	59	" 30	71	" 27	52
" 3	64	" 31	79	" 28	52.5
" 4	77	September 1	74	" 29	58.5

* Maximum thermometer out of order.

Two light frosts, slightly damaging on low ground the leaves of tender plants, occurred on September 18 and 26 and the first killing frost on October 8.

EXPERIMENTAL CROPS.

SOUTH SIDE PLOTS.

OATS.

As soon as enough ground had been cleared to make the sowing of any crop possible, the oats were put in. Three varieties were tested on plots two by five rods each. These varieties were the Big Four, Black Russian and the Golden Beauty. The seed germinated quickly and the young plants grew luxuriantly notwithstanding the excessive wetness of the season.

The variety, Big Four, was sown on May 17; it was harvested on August 28; it was then 4 feet and 4 inches high and yielded 43 bushels per acre. Strong growing variety to be recommended for this part of the Upper Peninsula.

The variety, Black Russian, was sown on May 17; it was harvested on August 28; was then 4 feet and 2 inches high and yielded 34 bushels per acre. Fairly good growing variety, but least able to withstand excessive rains.

The variety, Golden Beauty, was sown on May 18; it was harvested on August 28; was then 4 feet and 6 inches high and yielded 51 bushels per acre. Strongest growing variety among those tested and to be highly recommended. All varieties were affected by rust due to extremely wet weather, the black suffering more than the white varieties.

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BARLEY (On Plots 2x5 Rods).

Varieties of barley tested were the Manshury, 6-rowed, and the Royal, 2-rowed.

The variety, Manshury, was sown on May 17, and was harvested on September 4. It was then 3 feet and 6 inches high and yielded 32⅔ bushels per acre. Strong growing variety and good yielder under normal conditions. The variety, Royal, was sown on May 18; was harvested on September 4; was then 3 feet and 2 inches high and yielded 28 bushels per acre. This variety being sown on lower ground suffered more from excessive rains which caused both varieties to ripen unevenly.

SPRING RYE (On Plots 2x5 Rods).

Spring rye was sown on May 17; was harvested on August 23; was then 5 feet 9 inches high and yielded 29 bushels per acre. Slow in ripening for having been sown late, and badly affected by ergot.

SPRING WHEAT (On Plots 2x5 Rods).

The varieties of spring wheat tested were Wellman's Fife and Stanley.

The Wellman's Fife was sown on May 17; was harvested on September 7; was then 5 feet and 4 inches high and yielded 29 bushels per acre.

The Stanley was sown on May 18; was harvested on September 7; was then 5 feet and 2 inches high and yielded 21⅔ bushels per acre.

Both varieties, before heading out, showed the effects of excessive rains, being almost red with rust in spots; both, however, showed great power of recuperation, particularly the Stanley, which was sown on very low ground and often stood in four inches of water from two to five days at a time. Both may safely be recommended as strong growers and heavy yielders when grown under normal conditions.

FIELD PEAS (On Plots 2x5 Rods).

The varieties of field peas tested were the Improved Prussian Blue and the Black Marrowfat varieties.

The Improved Prussian Blue variety was sown on May 17; harvested on September 5. The vines were then 10 feet long and the yield was 42 bushels per acre.

The Black Marrowfat was sown on May 17; harvested September 5. The vines were then 10 feet long and the yield was 34 bushels per acre. Wet weather caused both varieties to blossom until harvest time. Both may be recommended as very strong growers and both were entirely free from insects. The fact that the Black Marrowfat was sown on much lower ground may account for the difference in yield.

BEETS, MANGELS, CARROTS, PARSNIPS, SALSIFY, LETTUCE, RADISHES, CABBAGE, ONIONS, SUGAR BEETS, PURPLE TOP, WHITE, YELLOW AND SWEDISH TURNIPS.

Except cabbage and onions, which were planted in rows 250 feet long, all of the crops above mentioned were sown between the rows of fruit trees and fruit bushes, in plots four by fifty feet each, three rows in each plot. All were sown on May 22, 23 and 24. Ten plots were entirely

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destroyed by cutworms, namely: The Prize Purple Top Swede, subsequently replaced by the same variety June 23, the Mammoth Long Red mangel, replaced June 25 by Jumbo Swede, the Intermediate mangel replaced June 25 by Jumbo Swede, the Giant Yellow Globe mangel, replaced by Purple Top Swede June 25, Scarlet Intermediate carrot, replaced June 25 by Purple Top Swede, Mammoth White carrot, replaced June 26 by Jumbo Swede, Giant White Vosges carrot, replaced by Long Red table radishes and lettuce June 25, Improved Short White carrot, replaced June 26 by Jumbo Swede, Danish Improved Red Top beet, replaced June 27 by Jumbo Swede, Golden Tankard mangel, replaced June 27 by Jumbo Swede.

One plot of Mammoth Long Red mangels was entirely destroyed by deer and the following plots were partially destroyed: Beets, Eclipse and Bassano; mangel, Perfection; stock beet, Danish Improved, and sugar beet, White Silesian.

The following plots on low, undrained ground, were partially destroyed by excessive rains: Turnips, White Swede, Hartley's Bronze Top, Empress and one plot each of Yellow Aberdeen, Swede Jumbo and Purple Top Swede. Including these six plots and the five partially destroyed by deer, the entire twenty-eight plots gave a total yield of 104½ bushels, being a yield of about 785 bushels per acre.

The following list gives the names of the varieties sown, the yield of each plot and the yield per acre for each plot:

No.	Variety.	Name.	Yield in bushels.	Yield per acre.
1	Turnip	White Swede	2½	544
2	"	Empress Swede	2½	544
3	"	Hartley's Bronze Top	3	653
4	"	Red Top Strap Leaf	5	1,089
5	"	Prize Purple Top Swede	3½	762
6	Parsnip	Hollow Crown	2	435
7	Salsify	Long White	1	218
8	Turnip	Prize Purple Top Swede	3½	762
9	Beets	Eclipse	2	435
10	"	Bassano	3¼	707
11	Turnip	Purple Top Swede	4¼	925
12	"	Jumbo, Swede	4½	980
13	"	Purple Top Swede	4¼	925
14	"	" " "	3½	762
15	"	Jumbo, Swede	4¼	925
16	"	" "	4	871
17	"	Purple Top Swede	4¼	925
18	"	Swede, Purple Top	6½	1,415
19	"	Swede, Jumbo	7	1,524
20	"	Greystone	6¾	1,470
21	"	Yellow Aberdeen	6	1,306
22	"	Purple Top Strap Leaf	4	871
23	"	Yellow Aberdeen	3½	762
24	"	Jumbo, Swede	3½	762
25	Mangel	Perfection	1	218
26	Turnip	Jumbo, Swede	3½	762
27	Sugar Beet	White Silesian	3½	762
28	Stock Beet	Danish Improved	2	435

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ONIONS (In Rows 250 Feet Long).

One row of onion sets was planted on May 25. While none attained a large size, those on high ground grew slightly above medium size, developed and ripened fairly well. Most of those on lower ground were worthless. The yield was 1½ bushels.

Two varieties of onion seed were sown on May 26, namely one row each of Red Cracker and Yellow Cracker. Very few merchantable bulbs were raised from either variety. Both varieties, as well as those raised from sets, were considerably damaged by maggots.

CABBAGE (In Rows 250 Feet Long, 3½ Feet Apart).

Cutworms and green cabbage worms did considerable damage to both the early and late variety. Excessive rains did less damage to the early variety planted on higher ground. The late variety was planted on the lowest ground of the south side plots and the yield cannot be considered more than 20 per cent of a normal crop.

One row of the early variety was planted on May 23 and ripened from August 15 to 20. The yield was 230 lbs., making a yield of 7 tons per acre. Five rows of the late variety were planted on June 19 and ripened very slowly after September 25. The yield was 320 lbs., giving an approximate yield of barely 1¾ tons per acre.

CELERY (In Rows 350 Feet Long).

Two varieties were planted June 20 on low bottom land, namely one row of Golden Self-Blanching and one row of White Plume. From shortly after planting until bleaching time the ground remained in a condition unfit for cultivation, the plants often standing in water from two to five days at a time, although the ground had been well prepared and thoroughly loosened by plowing twelve inches deep. The Golden Self-Blanching became practically valueless. The White Plume remained undersized, except a small portion of it on slightly elevated ground, which attained a height of 26 to 30 inches. The abnormal weather conditions did not otherwise affect the plants which possessed that rich flavor characteristic of northern climates.

POTATOES (18 Inches Apart, 4 Feet Between Rows).

Eight varieties of potatoes were planted on May 27, 28 and 29, with 3 to 5 eyes in each hill. Shallow cultivation was kept up until the first week in July, when on account of excessive rains, the hills were ridged just enough to leave a deep furrow in the center of each row. Potato beetles were not very numerous, requiring one spraying for the first brood and four for the second. On account of excessive rains all varieties commenced to show signs of leaf blight during blossoming time, and subsequently became seriously affected. All were entirely free from scab. They were harvested September 12, 15 to 20 per cent of the crop having rotted on account of the heavy rains during the preceding ten days. An additional loss of 10 per cent must be ascribed to seed rotting before germination on account of excessive rains, and to plants dying soon after germination, on such places where log heaps had been burned shortly before planting time and had left the ground saturated

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with an excess of potash. Of the total yield, 3 bushels, or 11 per cent were small and unmerchantable. The following is a list of the varieties planted, giving the yield in bushels of potatoes of merchantable size, the number of hills planted and the yield per acre.

Variety.	Hills.	Yield.	Approximate yield per acre.
Carman No. 1	136	1	56½
Carman No. 3	447	10	168¾
Roberts	216	3	102½
Harrington Peer	238	5	162
Battles Best	229	4½	142
Mill's Banner	230	4½	141½
Rose of Erin	201	5	179¾
Montana Rose	179	4	161½

STRAWBERRIES, FRUIT BUSHES, GRAPES AND FRUIT TREES.

The first planting done at the Station was the setting out of strawberry plants, fruit bushes and fruit trees, the work beginning May 10. Since no land was cleared on the first day of May, it could not be expected that the ground could be worked into a fit condition to receive plants raised many hundreds of miles south of the Station as early as they should be set out. Strawberry plants were sent earlier than the time set for shipment and arrived a week before the ground was ready. All other fruit varieties were delayed in transit, reaching the Station nearly three weeks after being shipped. A large percentage of them were in a very bad condition, the roots being nearly dried up. New shoots had in some instances grown fully two inches long and dried up again. Many plum and cherry trees had started to blossom. A second shipment of forty fruit trees arrived late in the season in extremely bad order and but eight survived. Careful nursing revived all other trees and plants, and but one plum tree failed to grow. Deep and thorough cultivation followed and was kept up continually until July, great pains being taken not to disturb the roots and but two gooseberry bushes died from improper planting. The excessive rains which followed materially injured all plants, gooseberry bushes being badly affected by mildew and currant bushes but slightly, while all fruit trees suffered from leaf curl and leaf blight; the apples severely, the plums nearly as much, the pears and cherries but slightly. Spraying against insects was made necessary once in each week until July and four more sprayings were applied thereafter. Quite a number of bushes were stunted and over a hundred strawberry plants lingered and finally died from an excessive amount of potash in the soil on the places where log heaps had been burned before planting time. Surface cultivation was kept up during July and the first part of August and fruit trees materially recovered from the effects of leaf blight during the last dry ten days of August. The hastening of wood ripening was rendered useless by the unceasing rains of September.

Strawberry plants were set out two feet apart, four feet between rows 400 feet long.

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All fruit bushes were planted four feet apart, eight feet between rows 300 feet long.

The sandy loam ground of the north side plots was intended for orchard purpose, but not being cleared at planting time, the fruit trees and grape vines were set out in nursery rows on the clay loam soil of the south side plots and the severer attack of leaf blight upon apple trees must be ascribed to the nature of the soil as much as to excessive rains.

Upon the size of the trees depended the resisting power to abnormal conditions, for while all apple trees survived and many made a splendid growth of new wood, a great number made but a feeble growth, the smaller trees, regardless of variety, faring worse. Out of fifty Shiawassees, for instance, which were small, one-year-old trees, but one made a new growth of sixteen inches, while none of the remaining 49 made a growth exceeding four inches.

If, thriving under adverse conditions may be taken as a safe basis (and no other ground could well be expected as a result of the work of the first season), the following varieties, having made the best growth, should prove desirable:

Strawberries: Seaford, Marshall, Excelsior, Michigan, Sample, the last two being the best.

Gooseberries: Downing, Columbus.

Currants: North Star, Prince Albert.

Raspberries: Loudon, Columbian.

Blackberries: Erie and Eldorado.

Grapes: Early Ohio, Concord.

The following varieties of fruit trees have made a new growth of 20 to 42 inches, those leading among the apple trees being the Haas, with a growth of 32 inches; pear trees: Flemish Beauty, with a growth of 30 inches; plum trees: Forest Garden, with a growth of 34 inches; cherry trees: Brusseller Braune, with a growth of 42 inches.

Apples: Walbridge, Wagener, Wealthy, Yellow Transparent, Gideon, Pewaukee, Duchess of Oldenburg, Tetofsky, Haas, Charlamoff.

Pears: Flemish Beauty, Vermont Beauty.

Plums: Moore's Arctic, Forest Garden, Wyant, Stoddard, De Soto.

Cherries: Lutorka, Brusseller Braune, Dyehouse, Early Richmond, Windsor, Gov. Wood.

EXPERIMENTAL CROPS.

NORTH SIDE PLOTS.

POTATOES (Hills 18 Inches Apart, 4 Feet Between Rows).

Three varieties were planted, one to three eyes in each hill, namely, the Rose of Erin, Roberts and Carman No. 3. Excessive rains did less damage to the plots on account of the better natural drainage and the more porous nature of the soil. Shallow cultivation was kept up, though the hills were slightly ridged during the last week in July with a view to insuring better drainage. But two sprayings for potato beetles

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were required. Very slight damage resulted from leaf blight, all were practically free from scab and the loss from rot caused by the heavy September rains amounted to less than 5 per cent at harvest time.

Seed destroyed by an excess of potash on places where log heaps had been burned before planting time amounted approximately to 5 per cent for Rose of Erin, 10 per cent for Carman No. 3 and 20 per cent for Roberts. The total yield gave 115¼ bushels of merchantable potatoes and 5 bushels of small potatoes.

"CARMAN NO. 3."

One thousand nine hundred and sixty-nine hills were planted June 3, 4 and 5. The yield was 53½ bushels, or 202½ bushels per acre.

"ROBERTS."

Five hundred and twenty-eight hills were planted June 11. The yield was 8½ bushels, or 127½ bushels per acre.

"ROSE OF ERIN."

One thousand four hundred and ninety-five hills were planted June 12, 13 and 14. The yield was 53¼ bushels, or 259 bushels per acre.

OATS.

Four varieties of oats were sown on June 16, namely, the Goanette Black, the Michigan Wonder, the Rhode Island Rustproof and the Scottish Chief, on plots covering an aggregate surface of 5 by 29 rods. Owing to the lateness of the season they were sown for hay. Excessive rains caused all varieties to rust, the Goanette Black being affected very badly, the Rhode Island Rustproof somewhat less, the Michigan Wonder moderately and the Scottish Chief the least. They were harvested September 18, the Goanette Black being then 28 inches high, the Michigan Wonder 40 inches, the Rhode Island Rustproof 36 inches and the Scottish Chief 38 inches. The yield was 8,250 lbs. or 4½ tons per acre.

RAPE.

One plot of Dwarf Essex rape was sown on June 16, covering a surface of 3x22 rods. Aside from slight damage to leaves by cabbage worms, the plants grew to perfection, reaching a height of 36 inches at the close of the season. The greatest portion of the plot was cut with a mowing machine at various times between September 20 and November 5, the stubble growing new thrifty plants 2 to 6 inches high in spite of the light September and the killing October frosts. The first snow fell on November 7, reaching a depth of 18 inches on November 15. The thermometer had registered as low as 16°, yet on November 16, the new grown plants under the snow, as well as the lower leaves of the old plants on the remaining uncut portion of the plot were apparently unhurt and thrifty, while the leaves above the snow were not seriously damaged. No more profitable crop for sheep can be recommended, nor one better adapted to the Upper Peninsula climate.

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PUMPKINS.

Twenty hills of the Small Sugar variety and 20 hills of the Large Mixed variety were planted on June 6, in hills 8 feet apart each way. Both varieties grew to perfection, unhampered by insects; 60 per cent ripened and the balance nearly so. No attempt was made at growing large specimens and the large variety yielded pumpkins weighing 20 to 25 lbs., while those of the small variety weighed 10 to 12 lbs.

POLE BEANS.

The Early Golden Cluster Wax variety was planted on June 5, the plot covering three rows 150 feet long, 4 feet apart and 2 feet between hills. Fifteen per cent failed to germinate or were destroyed by rabbits and excess of potash. None were allowed to ripen and the light September frosts left them unharmed. About one bushel were on the vines when the plants were killed by frost on October 8. Two and three-quarter bushels were picked between September 12 and October 1, which gives an approximate yield of 66 bushels per acre.

MILLET.

One plot of Japanese Millet was sown on June 18, covering a surface of 1½x22 rods. The entire plot had the best natural drainage and excessive rains did not materially affect it, the plants making a wonderful growth. Next to page 624 of the yearbook of the U. S. Department of Agriculture for 1899 may be seen an engraving representing a plot of this same variety, grown at the United States Grass Experiment Station, Walla Walla (Wash.), and showing it full grown, barely five feet high. The millet grown at this Station, when headed out attained an average height of 6 feet and 8 inches and a great many specimen plants were 7 feet high. The yield of the plot gave 5390 lbs. of green fodder, being equal to a yield of 13 tons of green fodder per acre. The light September frosts may possibly have arrested its further growth. The coarseness of the straw would indicate, however, that the chief value of this crop will be found in the silo.

CORN (In Hills 4 Feet Each Way).

Six varieties were planted June 7, 9 and 11 on plots 50 feet square, distanced 155 feet apart, namely, two varieties of Dent, three of Flint and one of Sweet corn. Cloud's Early Yellow Dent and Compton's Yellow Flint were planted June 7, Canada Yellow Flint and Gilman's Flint were planted June 9, the Early Butler Yellow Dent and Moore's Early Concord were planted June 11. Shallow cultivation was kept up during the entire season. A very light attack of smut affected all varieties and insects did considerable damage, while excessive rains caused rust to attack all varieties except the Early Butler, which was but slightly affected. Of the two Dent varieties, Cloud's grew to a height of nine feet while the Early Butler averaged ten feet. There is a widespread belief, akin to superstition, that, aside from sweet corn, it would be useless to try to raise corn in the Upper Peninsula. The Cloud and Canada varieties, being planted adjacent to a public highway, curiosity impelled passers-by to strip off most of the ears and to this must be

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ascribed the smaller yield. The prudent husbandman in regions, even hundreds of miles south of the Station, would not consider it safe to plant corn as late as June 9, yet all varieties were well advanced in the glazing stage at the close of the season, while 10 per cent of the Gilman and 20 per cent of the Compton varieties were thoroughly ripened, the difference in percentage being perhaps due to the topping off process which was resorted to upon one-half of the hills of the Compton variety.

Varieties.	Yield of corn in ears. Bushels.	Approximate yield per acre. Bushels.
Early Butler Yellow Dent	4½	78
Compton's Yellow Flint	3½	60¾
Cloud's Early Yellow Dent	2	34½
Gilman's Flint	3½	60¾
Moore's Early Concord	9	156
Canada Yellow Flint	1¼	21¾

THE GEOLOGY AND BOTANY OF THE UPPER PENINSULA EXPERIMENT STATION.

C. F. WHEELER.

I left the College August 20, in company with Prof. R. H. Pettit, for Chatham, Upper Peninsula, to examine the soil and forest covering of the Sub-Station. Owing to the short time spent in the work a preliminary report only can be made at this time. Collections of flowering plants; ferns, mosses, liverworts and fungi were made and notes on the distribution of the same. Especial attention was given to trees, weeds, plant diseases, and edible fungi, which were very abundant.

LOCATION.

The Sub-Station of the Michigan State Agricultural College Experiment Station is located at Chatham, Rock River township, Alger county, on the southeast quarter section 28, range 46 north and 21 west. The Station land is eight miles south of Lake Superior; twenty-five miles southeast from Marquette and fourteen miles southwest from Munising, and is traversed by the line of the Munising railroad, which cuts off a few rods near the south line.

TOPOGRAPHY.

Chatham is situated on a plateau about two hundred and seventy-five feet above the level of Lake Superior. The Station land lies in a valley formed by the action of Slap Neck Creek, a rather rapid stream flowing eastward and southward to the Au Train river, into which it empties about six miles away. This creek enters the quarter section near the northwest corner and divides it into two unequal parts. The

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valley is one-half mile wide and about sixty-five feet deep. The creek has left five distinct terraces since it began to flow at its highest level. However, it is possible that moving ice may have helped in carving out the valley about the time of the last ice flow.

GEOLOGY.

To make the geological conditions plain it will be necessary to state that the eastern portion of the Upper Peninsula from Marquette southward to the Sturgeon river is made up of seven different rock formations, which, beginning on the south shore of Lake Superior are known as—first, the Potsdam sandstone; second, Calciferous sand rock; third, Trenton rocks; fourth, Hudson river rocks; fifth, Niagara rocks; sixth, a very small area of the Onondaga rocks, and seventh, the Helderberg rocks—about St. Ignace and Mackinac Island. These formations represent the oldest sedimentary rocks found in the United States.

For the most part these groups of rocks are covered more or less by the drift, which consists of sands, gravels and clays spread over them during the ice period, when the great northern glaciers covered this portion of North America.

The Station is situated upon the second group of rocks south of Lake Superior, known as the Calciferous sand rock, which here lies in nearly horizontal layers of varying thickness and consistency.

Many of the layers are hard and crystaline and make excellent building stone. The stone for the Munising High School building was taken from an outcrop near the railroad station. This outcrop extends across the south side of the Station grounds. In the lower terraces the outcrop is very friable, easily decomposing into soil of excellent quality. The following extract from the State Geologist, Dr. Alfred C. Lane, may be quoted here as giving a good account of the geological conditions.

"The valley, which is the main topographic feature, is a black muck flood plain, and is bordered by a series of terraces, which are sandy, with black soil tops. The rock is exposed in gutters of the road and elsewhere. On the south side it is a sandy dolomite, and the same formation seems to continue at intervals for a mile south, where there are heavy ledges exposed. On the north side the ledges exposed in the ditch are more calcareous, that is, effervesces more freely in acids, and there are some genuine streaks of clay shales. On the whole, therefore, the site affords a considerable variety of exposure and soil, and while it is rather sandy, it is by no means so light as farther north, and possibly it might be classed as a light sandy loam."

Dr. C. Rominger, State Geologist, in his Report on the Palæozoic Rocks of the Upper Peninsula in 1872, page 107, makes the following statements: "We see at once the greater value of the western districts, which rival any other part of the world in mineral wealth. But I think, too, that the eastern part of the Peninsula has enough of less striking sources of prosperity to make it a precious part of our country and a desirable home for many. Already of high importance are the extended pine lands, which furnish us with excellent lumber, and will do so for a great many years to come, particularly if more care should be taken to prevent the fires which every year destroy thousands of acres of the finest forests."

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Not less valuable are the widely extended hardwood lands, stocked with excellent timber for fuel and other purposes, to which up to the present time comparatively little attention has been paid, but which soon will be in demand, with the rapid increase of our iron industry. The ample water power of the rivers, the limestone for the flux, sandstones for the buildings right at hand, and the lakes an open street to all parts of the country, are advantages not found everywhere.

With the clearing of the hardwood lands, a large area of fertile land will be open for tillage. It will be perhaps said that the severity of the climate is an objection to the cultivation of these fertile lands. It is true the winters are much longer there than in the south part of our State, and corn and wheat prove to be very uncertain crops, but potatoes, oats and grass particularly grow as finely there as further south, and the few farmers who have settled here and there seem to be doing very well. The mining districts are always an open, profitable market for their products; the lumber or fur trade is a considerable additional income to them, or gives them employment if they seek it, and those near the lake have a rich harvest in the fisheries. With the increase of inhabitants in these districts, the facilities for all will be improved, and perhaps the time is not far distant when this neglected forest country shall justify the application of our State motto: "Si quaeris Peninsulam amoenam, circumspice."

NOTES ON SOME OF THE TREES GROWING IN THE STATION WOODS.

The basswood (*Tilia Americana*) is, or has been, a frequent tree along the outcrop of the Calciferous sand rock. This valuable lumber tree is of large size and excellent quality in this part of Michigan. However, it is rapidly disappearing, as it is now much sought after by lumbermen. An interesting fact is that young trees are springing up everywhere about the old stumps. Many of them are seedlings, and the whole region seems likely to be re-forested in a short time.

The sugar maple (*Acer saccharinum*) is by far the most abundant tree growing on the station grounds. This tree constitutes half of the forest growth in the vicinity of Chatham. The trees are not of large size, ranging from one to two feet in diameter and about sixty feet in height. Some of these trees show signs of disease, and the attempt to turn them into lumber has not thus far been successful. The sugar season is short and the production of maple sugar is not carried on to any great extent.

Red maple (*Acer rubrum*). This is a rare tree along the banks of streams.

Black ash (*Fraxinus sambucifolia*). This tree is only seen along streams and in swampy places, accompanying white cedar.

Elm (*Ulmus Americana*). This noble tree is quite common and grows to a large size. One old tree which the lumbermen left, measured twenty-three feet eight inches in girth four feet from the ground. This tree is also rapidly disappearing, being lumbered extensively at the present time.

Beech (*Fagus ferruginea*). Only an occasional tree of small size was seen on the station grounds.

Ironwood (*Ostrya Virginica*). This tree is frequent and reaches a large size in the Alger county woods.

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Cherry birch (*Betula lenta*). A frequent tree of good size, but not common enough to yet tempt the lumbermen. The same may be said of the

Yellow birch (*Betula lutea*).

Aspen (*Populus tremuloides*). This is the only poplar noticed in the vicinity of the station, and it is not common.

White pine (*Pinus strobus*). Only a few large stumps of this valuable tree were seen.

Balsam fir (*Abies balsamea*). This beautiful tree is scattered throughout the forests, and often reaches a large size.

Hemlock (*Tsuga Canadensis*). This tree, which is so common along the shore of Lake Superior on the sandy ridges is seldom seen at Chatham.

Tamarack (*Larix Americana*). This tree is occasionally seen outside of swamps, where it is abundant and of large size.

White cedar (*Thuya occidentalis*). The white cedar is one of the most valuable trees in the forests of Alger county. It has two places in which it flourishes, viz., large swamps, accompanied by tamarack and black spruce; also in small areas on side hills, where springs come out from the rocks, are many fine specimens of very large size. Here this tree grows in clusters, half a dozen or more trunks branching out from a single root.

LIST OF [redacted] PLANTS, TREES AND SHRUBS GROWING ON THE STATION GROUNDS.

Moonwort, *Botrychium Virginianum*, Swartz.
Maidenhair, *Adiantum pedatum*, L.
Shield-fern, *Aspidium spinulosum intermedium*, D.C.
Holly-fern, *A. Lonchitis*, Swartz.
Goldie's-fern, *A. Goldieanum*, Hook.
Narrow-leaved Spleenwort, *Asplenium angustifolium*, Michx.
Silvery Spleenwort, *A. thelypteroides*, Michx.
Lady-fern, *A. Felix-foemina*, Bernh.
Bladder-fern, *Cystopteris bulbifera*, Bernh.
Sensitive-fern, *Onoclea sensibilis*, L.
Ostrich-fern, *O. struthiopteris*, Hoff.
Cinnamon-fern, *Osmunda cinnamomea*, L.
Long Beech-fern, *Phegopteris polypodioides*, Fee.
Oak-fern, *P. Dryopteris*, Fee.
Common Horsetail, *Equisetum arvense*, L.
Wood Horsetail, *E. sylvaticum*, L.
Swamp Horsetail, *E. limosum*, L.
Common Scouring Rush, *E. hyemale*, L.
Sedge-like Equisetum, *E. scirpoides*, Michx.
Shining Club-moss, *Lycopodium lucidulum*, Michx.
White Pine, *Pinus strobus*, L.
White Spruce, *Picea alba*, Link.
Black Spruce, *P. nigra*, Link.
Hemlock, *Tsuga Canadensis*, Carr.
Balsam Fir, *Abies balsamea*, Miller.
Tamarack, *Larix Americana*, Michx.
White Cedar, *Thuya occidentalis*, L.
Ground Hemlock, *Taxus Canadensis*, Willd.

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Common Cat-tail, *Typha latifolia*, L.
Bur-reed, *Sparganium simplex*, Hudson.
Indian Turnip, *Arisaema triphyllum*, Torr.
Duckweed, *Lemna minor*, L.
Pondweed, *Potamogeton rufescens*, Schrader.
Pondweed, *P. Richardsonii*, Bennett.
Quack-grass, *Agropyron repens*, Beauv.
Red top, *Agrostis alba*, L.
Hair Grass, *A. scabra*, Willd.
Bottle-brush Grass, *Asprella Hystrix*, Willd.
~~Bottle-brush Grass~~, *Avena Smithii*, Porter.
~~Bottle-brush Grass~~, *Brachyelytrum aristatum*, Beauv.
Brome-grass, *Bromus ciliatus*, L.
Blue-joint, *Calamagrostis Canadensis*, Beauv.
Wood Reed-grass, *Cinna pendula*, Trin.
Wild Rye, *Elymus Virginicus*, L.
Wild Rye, *E. Canadensis*, L.
Nodding Fescue-grass, *Festuca nutans*, Willd.
Meadow Fescue-grass, *F. elatior var, pratensis*, Gray.
Manna-grass, *Glyceria nervata*, Trin.
Squirrel-tail Grass, *Hordeum jubatum*, L.
Millet-grass, *Milium effusum*, L.
Mountain-rice, *Oryzopsis asperifolia*, Michx.
Common Crab Grass, *Panicum sanguinale*, L.
Old-witch Grass, *P. capillare*, L.
Barnyard-grass, *P. crus-galli*, L.
Timothy, *Phleum pratense*, L.
Low Spear-grass, *Poa annua*, L.
English Blue Grass, *P. compressa*, L.
June Grass, *P. pratensis*, L.
Foxtail, *Setaria glauca*, Beauv.
Bottle-grass, *S. viridis*, Beauv.
Sedge, *Carex intumescens*, Rudge.
Sedge, *C. lupulina*, Muhl.
Sedge, *C. retrorsa*, Schwein.
Sedge, *C. Pseudo-cyperus*, L.
Sedge, *C. stricta*, Lam.
Sedge, *C. arctata*, Boott.
Sedge, *C. arctata Faxoni*, Bailey.
Sedge, *C. granularis*, Muhl.
Sedge, *C. laxiflora, striatula*, Carey.
Sedge, *C. Careyana*, Torr.
Sedge, *C. plantaginea*, Lam.
Sedge, *C. varia*, Muhl.
Sedge, *C. communis*, Bailey.
Sedge, *C. pubescens*, Muhl.
Sedge, *C. Backii*, Boott.
Sedge, *C. stipata*, Muhl.
Sedge, *C. vulpinoidea*, Michx.
Sedge, *C. rosea*, Schkuhr.
Sedge, *C. Deweyana*, Schwein.
Sedge, *C. tribuloides reducta*, Bailey.
Sedge, *C. tribuloides Bebbii*, Bailey.

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Sedge, *C. cristata*, Bailey.
Sedge, *C. sychnocephala*, Carey.
Sedge, *Cyperus speciosus*, Vahl. (introduced).
Spike-rush, *Eleocharis acicularis*, R. & S.
Spike-rush, *E. intermedia*, Shultes.
Cotton Grass, *Eriophorum atrocinctus*, Fernald.
Common or Soft Rush, *Juncus effusus*, L.
Slender Rush, *Juncus tennis*, Willd.
Wild Leek, *Allium tricoccum*, Ait.
Smaller Solomon's Seal, *Polygonatum, biflorum*, Ell.
False Spikenard, *Smilacina racemosa*, Desf.
False Solomon's Seal, *S. stellata*, Desf.
Dwarf Solomon's Seal, *Maianthemum Canadense*, Desf.
Twisted-stalk, *Streptopus roseus*, Michx.
Bear-tongue, *Clintonia borealis*, Raf.
Bellwort, *Uvularia perfoliata*, L.
Wake Robin, *Trillium grandiflorum*, Salisb.
Wake Robin, *T. cernuum*, L.
Larger Blue Flag, *Iris versicolor*, L.
Long-bracted orchis, *Habenaria bracteata*, R. Br.
Northern green orchis, *H. hyperborea*, R. Br.
Northern white orchis, *H. dilatata*, Gray.
Shining Willow, *Salix lucida*, Muhl.
Sand-bar Willow, *S. longifolia*, Muhl.
Bebb's Willow, *S. rostrata*, Richardson.
Glaucous Willow, *S. discolor*, Muhl.
Slender Willow, *S. petiolaris*, Smith.
American Aspen, *Populus tremuloides*, Michx.
Balsam Poplar, *P. balsamifera*, L.
Cherry Birch, *Betula lenta*, L.
Yellow Birch, *B. lutea*, Michx. f.
Hoary Alder, *Alnus incana*, Willd.
Beaked Hazel-nut, *Corylus rostrata*, Ait.
Iron-wood, *Ostrya Virginica*, Willd.
Beech, *Fagus ferruginea*, Ait.
White or American Elm, *Ulmus Americana*, L.
Nettle, *Urtica gracilis*, Ait.
Wood-nettle, *Laportea Canadensis*, Gaud.
Small Mistletoe, *Arceuthobium pusillum*, Peck.
Great Water-dock, *Rumex Britannica*, L.
White Dock, *R. salicifolius*, Weinm.
Narrow Dock, *R. crispus*, L.
Bitter Dock, *R. obtusifolius*, L.
Sheep Sorrel, *R. acetosella*, L.
Knot-grass, *Polygonum aviculare*, L.
Pale Persicaria, *P. lapathifolium*, L.
Lady's Thumb, *P. Persicaria*, L.
Common Smartweed, *P. Hydropiper*, L.
Shore Knotweed, *P. littorale*, Link.
Black Bindweed, *P. convolvulus*, L.
Fringed Black Bindweed, *Polygonum cilinode*, Michx.
Maple-leaved Goosefoot. *Chenopodium hybridum*, L.
Lambs' Quarters, *C. album*, L.

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Strawberry Blite, *C. capitatum*, Watson.
Pigweed, *Amarantus retroflexus*, L.
Water-Hemp, *Acnida tuberculata*, Moq.
Common Purslane, *Portulaca oleracea*, L.
Night-flowering Catchfly, *Silene noctiflora*, L.
Mouse-eared Chickweed, *Cerastium vulgatum*, L.
Yellow Pond-Lily, *Nuphar advena*, Aiton, f.
Common Virgin's Bower, *Clematis Virginiana*, L.
Liver-leaf, *Hepatica triloba*, Chaix.
Early Meadow-Rue, *Thalictrum dioicum*, L.
Purplish Meadow-Rue, *T. purpurascens*, L.
White Water-Crowfoot, *Ranunculus aquatilis var trichophyllus*, Gray.
Small-flowered Crowfoot, *Ranunculus abortivus*, L.
Hooked Crowfoot, *R. recurvatus*, Poir.
Hooked Crowfoot, *R. septentrionalis*, Poir.
Hooked Crowfoot, *R. Macounii*, Britton.
Tall Crowfoot or Buttercup, *R. acris*, L.
Marsh Marigold or Cowslips, *Caltha palustris*, L.
Goldthread, *Coptis trifolia*, Salisb.
Wild Columbine, *Aquilegia Canadensis*, L.
Red Baneberry, *Actaea spicata var, rubra*, Ait.
White Baneberry, *A. alba*, Bigelow,
Pappoose-root, *Caulophyllum thalictroides*, Michx.
Moonseed, *Menispermum Canadense*, L.
Blood-root, *Sanguinaria Canadensis*, L.
Dutchman's Breeches, *Dicentra cucullaria*, D. C.
Squirrel Corn, *D. Canadensis*, D. C.
Pepper-root, Crinkle-root, *Dentaria diphylla*, L.
Land Cress, *Cardamine Pennsylvanica*, Muhl.
Land Cress, *C. parviflora*, *L.*
Marsh Cress, *Nasturtium terrestre*, R. Br.
Worm-seed Mustard, *Erysimum cheiranthoides*, L.
Hedge Mustard, *Sisymbrium officinale*, Scop.
Tumbling Mustard, *S. altissumum*, L.
English Charlock, *Brassica Sinapistrum*, Boiss.
Shepherd's Purse, *Capsella Bursa-pastoris*, Moench.
Wild Peppergrass, *Lepedium apetalum*, Willd.
Field Cress, *L. campestre*, R. Br.
False Miter-Wort, *Tiarella cordifolia*, L.
Bishop's Cap, *Mitella nuda*, L.
Golden Saxifrage, *Chrysosplenium Americanum*, Schwein.
Gooseberry, *Ribes cynosbati*, L.
Gooseberry, *R. lacustre*, Poir.
Fetid currant, *R. prostratum*, L'Her.
Wild Black Currant, *R. floridum*, L'Her.
Red Currant, *Ribes rubrum var. subglandulosum*, Maxim.
Choke-Cherry, *Prunus Virginiana*, L.
Wild Black Cherry, *P. serotina*, Ehrh.
Nine-bark, *Physocarpus opulifolius*, Maxim.
Dwarf Raspberry, *Rubus triflorus*, Richard.
Wild Red Raspberry, *R. strigosus*, Michx.
Blackberry, *R. Canadensis*, L.
Avens, *Geum album*, Gmelin.

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Water or Purple Avens, *G. rivale*, L.
Strawberry, *Fragaria Americana* (Porter) Britt.
Norway Cinquefoil, *Potentilla Norvegica*, L.
American Mountain Ash, *Pyrus Americana*, D. C.
Ash-leaved Mountain Ash, *P. sambucifolia*, C. and S.
Scarlet Hawthorn, *Crataegus coccinea*, L.
Pear-thorn, *C. tomentosa*, *L.*
Service-berry, *Amelanchier Canadensis*, Torr. and Gray.
Red Clover, *Trifolium pratense*, L.
White Clover, *T. repens*, L.
Alsike Clover, *T. hybridum*, L.
Common Vetch, *Vicia sativa*, L.
Carolina Crane's-bill, *Geranium Carolinianum*, L.
Common Wood Sorrel, *Oxalis Acetosella*, L.
Thyme-leaved Spurge, *Euphorbia serpyllifolia*, Pers.
Water Starwort, *Callitriche autumnalis*, L.
Mountain Maple, *Acer spicatum*, Lam.
Sugar Maple, *A. saccharinum*, Wang.
Red or Swamp Maple, *A. rubrum*, L.
Spotted Touch-me-not, *Impatiens fulva*, Nutt.
Buckthorn, *Rhamnus alnifolia*, L'Her.
Basswood, *Tilia Americana*, L.
Common Blue Violet, *Viola cucullata*, Ait.
Sweet White Violet, *V. blanda*, Willd.
White Violet, *V. blanda var. palustriformis*, Gray.
Kidney-leaved Violet, *V. renifolia*, A. Gray.
Yellow Violet, *V. scabrinscula*, (T. & G.) Schwein.
Canada Violet, *V. Canadensis*, L.
Muhlenberg's Violet, *V. canina var. Muhlenbergii*, Gray.
Violet, *V.*, new species.
Moosewood, *Dirca palustris*, L.
Great Willow-herb, *Epilobium spicatum*, Lam.
Great Willow-herb, *E. adenocaulon*, Haussk.
Common Evening Primrose, *Oenothera biennis*, L.
Smaller Enchanter's Nightshade, *Circaea alpina*, L.
Spikenard, *Aralia racemosa*, L.
Wild Sarsaparilla, *A. nudicaulis*, L.
Cow Parsnip, *Heracleum lanatum*, Michx.
Water Parsnip, *Sium cicutaefolium*, Gmelin.
Sweet Cicely, *Osmorrhiza brevistylis*, D. C.
Sanicle, *Sanicula Marylandica*, L.
Bunch-berry, *Cornus Canadensis*, L.
Dogwood, *C. alternifolia*, L. f.
Red-Osier, *C. stolonifera*, Michx.
Shin-leaf, *Pyrola secunda*, L.
Blue-berry, *Vaccinium Canadense*, Kalm.
Trailing Arbutus, *Epigaea repens*, L.
Star-flower, *Trientalis Americana*, Pursh.
Black Ash, *Fraxinus sambucifolia*, Lam.
Spreading Dogbane, *Apocynum androsaemifolium*, L.
Common Hound's Tongue, *Cynoglossum officinale*, L.
Stickseed, *Echinosperum Lappula*, Lehm.
Blue Vervain, *Verbena hastata*, L.

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Wild Mint, *Mentha Canadensis*, L.
Bugle-weed, *Lycopus Virginicus*, L.
Bugle-weed, *L. sinuatus*, Ell.
Mad-dog Skullcap, *Scutellaria lateriflora*, L.
Mad-dog Skullcap, *S. galericulata*, L.
Heal-All, *Brunella vulgaris*, L.
Common Hemp-Nettle, *Galeopsis Tetrahit*, L.
Basil, *Calamintha clinopodium*, Benth.
Figwort, *Scrophularia nodosa var. Marilandica*, Gray.
Monkey Flower, *Mimulus ringens*, L.
False Pimpernel, *Ilysanthes riparia*, Raf.
American Brooklime, *Veronica Americana*, Schwein.
American Brookline, *Chelone glabra*, L.
Common Plantain, *Plantago major*, L.
Patridge Berry, *Mitchella repens*, L.
Small Bedstraw, *Galium trifidum pusillum*, Gray.
Rough Bedstraw, *G. asprellum*, Michx.
Sweet-scented Bedstraw, *G. triflorum*, Michx.
Red-berried Elder, *Sambucus racemosa*, L.
Cranberry Tree, *Viburnum Opulus*, L.
Horse-Gentian, *Triosteum perfoliatum*, L.
Twin-flower, *Linnaea borealis*, Gronov.
Fly-Honeysuckle, *Lonicera ciliata*, Muhl.
Bush-Honeysuckle, *Diervilla trifida*, Moench.
Joe-Pye Weed, *Eupatorium purpureum*, L.
Thoroughwort, *E. perfoliatum*, L.
White Snake-root, *E. ageratoides*, L.
Golden-rod, *Solidago uliginosa*, Nutt.
Golden-rod, *S. Canadensis*, L.
Golden-rod, *S. serotina*, Ait.
Aster, *Aster macrophyllus*, *L.*
Aster, *A. puniceus*, L.
Aster, *A. diffusus*, Ait.
Aster, *A. paniculatus*, Lam.
Fleabane, *Erigeron Canadensis*, L.
Pearly Everlasting, *Anaphalis margaritacea*, B. and H.
Common Everlasting, *Gnaphalium polycephalum*, Michx.
Common Everlasting, *G. decurrens*, Ives.
Swamp Beggar-ticks, *Bidens connata*, Muhl.
Smaller Bur-Marigold, *B. cernua*, L.
Larger Bur-Marigold, *B. chrysanthemoides*, Michx.
May-weed. *Anthemis Cotula*, D. C.
Yarrow, *Achillea Millifolium*, L.
Ox-eye or White Daisy, *Chrysanthemum Leucanthemum*, L.
Wormwood, *Artemisia biennis*, Willd.
Life-root, *Senecio Balsamitae*, Torr. and Gray.
Fireweed, *Erechtites hieracifolia*, Raf.
Common or Bull Thistle, *Cnicus lanceolatus*, Hoffm.
Swamp Thistle, *C. muticus*, Pursh.
Canada Thistle. *C. arvensis*, Hoffm.
White Lettuce, *Prenanthes alba*, L.
Common Dandelion, *Taraxacum officinale*, Weber.

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Wild Lettuce, *Lactuca Canadensis*, L.
Wild Lettuce, *L. leucophaea*, Gray.
Spiny-leaved Sow-Thistle. *Sonchus asper*. Vill.

LIST OF INTRODUCED WEEDS.

Tall Buttercups, *Ranunculus acris*.
Hedge Mustard, *Sisymbrium officinale*.
Tumbling Mustard, *S. altissimum*.
Charlock, *Brassica Sinapistrum*.
Shepherd's Purse, *Capsella Bursa-pastoris*.
Field Cress, *Lepidium Campestre*.
Night-flowering Catchfly, *Silene nochtiflora*.
Mouse-ear Chickweed, *Cerastium vulgatum*.
Common Purslane, *Portulaca oleracea*.
May-weed, *Anthemis Cotula*.
Ox-eye Daisy, *Chrysanthemum Leucanthemum*.
Canada Thistle, *Cnicus arvensis*.
Bull Thistle, *C. lanceolatus*.
Common Dandelion, *Taraxicum officinale*.
Spiny-leaved Sow-Thistle, *Sonchus asper*.
Stick-seed, *Echinospermum Lappula*.
Common Hound's Tongue, *Cynoglossum officinale*.
Common Hemp-Nettle, *Galeopsis Tetrahit*.
Pigweed, *Amarantus retroflexus*.
Lamb's Quarters, *Chenopodium album*.
Narrow-leaved Dock, *Rumex crispus*.
Bitter Dock, *R. obtusifolius*.
Lady's Thumb, *Polygonum Persicaria*.
Quack Grass, *Agropyron repens*.
Goose Grass, *Polygonum aviculare*.

LIST OF WEEDS INTRODUCED IN PACKING MATERIAL FROM PAINESVILLE, OHIO, IN 1900.

Rugel's Plantain, *Plantago Rugellii*.
Slender Rush, *Juncus tenuis*.
Witch Grass, *Panicum capillare*.
Barnyard Grass, *P. crus-galli*.
Finger-grass, *P. sanguinale*.
Sheep Sorrel, *Rumex acetosella*.
Pigeon Grass, *Setaria viridis*.
Pigeon Grass, *S. glauca*.
Stink-Grass, *Eragrostis major*.
Stink-Grass, *E. Purshii*.
Bull Thistle, *Cnicus lanceolatus*.
Sow-Thistle, *Sonchus oleraceus*.
Pigweed, *Amarantus retroflexus*.
Michaux's Cyperus, *Cyperus speciosus*.

DISEASES NOTICED ON CULTIVATED PLANTS.

The following is a list of fungi causing plant diseases which were collected on the station grounds, specimens of which have been placed the Herbarium:

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Early blight on potatoes.

Rusts were plentiful on wheat, oats, rye and barley.

(The fact that the seed grains were brought from a distance and that no crops of barley, wheat or rye were grown in the immediate neighborhood, tends to strengthen the theory that rust may exist in the seed.)

Leaf spot on strawberries.

Rust on corn.

Shot-hole fungus on plums and cherries.

Mildew on gooseberries.

Spot disease on gooseberries.

Alternaria on turnips.

Leaf spot on sugar beets.

"Sun scald" injured some of the young shoots of newly set apples in August, but the trees had recovered by September first.

The following plants are reported from the Upper Peninsula for the first time, all found in the station woods:

Aspidium Goldianum.

Asplenium augustifolium.

Carex Careyana.

Carex sychnocephala.

Triosteum perfoliatum.

A violet was found in fruit, which is probably unnamed.

THE DWARF MISTLETOE IN MICHIGAN.

One plant new to the State was found, which deserves notice from the fact that it is a parasite on the black spruce. This plant is the dwarf mistletoe (*Arceuthobium pusillum*, Peck). This mistletoe was found August 30th in a tamarack swamp, a fourth of a mile north of the station. The plant is only an inch high, but makes up in numbers what it lacks in size. The male and female plants are usually found on different trees. They stand thickly on the upper sides of the branches. The female plants first appear on two-year-old branches, and the fruiting plants do not perfect their seeds until they are two years old, so they are plentiful on four-year-old branches, and some were seen on even older branches; in one case the affected branch was twelve years old. The male plants first appear on three-year-old wood. The seeds ripen early in September, being covered with a sticky substance and being expelled with considerable force from the fruits, they stick to the branches, where they germinate and enter the host tree. The effect on the tree is remarkable. When a tree is attacked by this parasite, the branch affected is stimulated to an extra growth, forming dense clusters of spindling branches, which take an upright growth, forming large bunches on the trees, which are readily noticed. These clusters have the common name of witch's brooms, Hexenbesen, the Germans call them. These witch's brooms continue to increase in size, and when a number of branches are diseased, the tree finally dies as a result of the attack. This parasite is widely distributed in the Upper Peninsula. I saw it in nearly every swamp from Chatham to Soo Junction, a distance of one hundred miles. In some of these swamps nearly every tree had been killed.

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The damage done by the mistletoe is considerable, but just how great cannot be determined without farther examination. While examining the plants in the office, I found that the mistletoe was also attacked by a fungous parasite, which must have a tendency to check the spread of this pest. Each fruit is attacked at its apex by the fungus *Wallrothiella arceuthobii*, Peck, and, of course, destroyed. This mistletoe was first found by Mrs. L. A. Millington, a former resident of Michigan, at Warrensburg, New York. It was discovered the same year by C. H. Peck, state botanist of New York, who also found the fungus, and who gave both parasites their names. The cuts on earlier pages give a good notion of healthy and diseased spruce trees.

C. F. WHEELER,
Botanist of Experiment Station,

Agricultural College, Nov. 1, 1900.

INSECT AND ANIMAL LIFE ON THE UPPER PENINSULA EXPERIMENT STATION.

R. H. PETTIT, ENTOMOLOGIST.

INTRODUCTION.

During the latter part of August the writer, in company with Professor Wheeler, visited the State Sub-station at Chatham, remaining there about twelve days. Afterward a visit was made to Beaver Island, in Lake Michigan. During all the time the object of the writer was to obtain specimens of as many forms of animal life as possible, with special reference to economic species. The following brief report deals mainly with the life at Chatham, although the list of shells and spiders includes those at Beaver Island as well.

The time of the year was not an ideal one for collecting, although for economic work it was perhaps as good as any. Considerable time was consumed in preparing specimens, both vertebrate and insect, and in taking photographs; and, of the material collected, it is at present impossible to include a considerable part, as a number of the insects are still in the breeding cages, and very many more will have to be sent to specialists for identification.

The writer wishes to extend his thanks to Dr. Bryant Walker, of Detroit, who has kindly determined the molluscs; to Mr. Nathan Banks, of the Division of Entomology at Washington, who did the same for the spiders, the Neuroptera and the Trichoptera; to Prof. W. S. Blatchley, State Geologist of Indiana, for determining one of the grasshoppers, credit for which is given in the text; to Mr. Matt Crosby for the privilege of examining his collection, made at Chatham during the past season, insects listed from his collection being marked with his name; and to Mr. Leo Geismar for aid and kindness shown in many ways.

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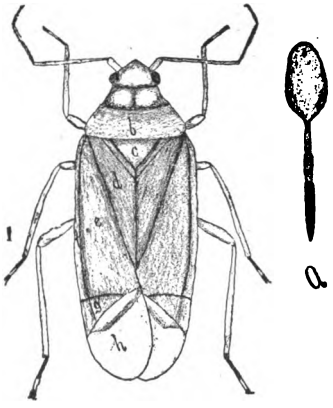
TREE-HOPPERS AND LEAF-BUGS.

(Jassidae and Capsidae.)

Many species of small tree-hoppers, leaf-bugs and other sucking insects were found in the regions visited. It will not be necessary to go into exact details in discussing them, since the same general remedies serve against almost all of them. They are very small insects, usually elongated and often green or pale in color, though some of them are brightly colored. The feeding habits of the different kinds of insects in this class are very much alike, except that each species usually is restricted to a limited number of food-plants. They are provided with sharp, sucking beaks, which extract the sap and juices from trees and plants of all sorts. Some of them work on grasses. The effect is the gradual decline of the plant attacked. If the plant is of any size, this injury may go on and stop at any point, depending on the amount of food extracted and the damage due to the wounds of the beaks. Unless the insects are seen to be present, the exact cause of the injury is often difficult to locate, as the punctures are very small and the wounds are not conspicuous.

Many of these small sucking insects are to be found in the Upper Peninsula as well as in the Lower, and in spite of the fact that vegetation is vigorous, the tax levied by these apparently insignificant insects is quite a heavy one. The remedy is the same for all—spraying with a strong tobacco extract when they are seen to be at work, and the destruction of rubbish in the winter time.



Hollyhock bug, (*Orthotylus delicatus*), from Cook and Davis, Bull. 76, Mich. Exp. Station.

While probably they never can be exterminated by the methods advised, beneficial results certainly will follow the practice if it is conscientiously carried out from year to year. Insects of this class, most of them, pass the winter in rubbish and in out of the way places. Now, the destruction of all rubbish after the cold weather has once set in will do away with great numbers of the insects. This is especially true in towns and in regions not wooded. In new clearings many of

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the insects will resort to the woods for shelter, and of course cannot be reached, but the general practice of clean culture will prove of noticeable and lasting benefit.

THE CANOE-BIRCH COCCID.

(*Xylococcus betulae*, Hub. & Schw.)

This interesting scale-insect was found at Munising and at Harbor Springs. It was first found by Messrs. Hubbard and Schwarz at Michipicoten and near Marquette, both on Lake Superior. The insect works in the bark of canoe-birch, making cavities in the bark and splitting the layers so that it becomes useless for the purpose of canoe making. Mr. Hubbard says:* "In 1876, when Mr. Schwarz and I visited the north shore of the lake at Michipicoten River, we were told that the Indians were obliged to go sixty miles back into the interior in order to find sheets of bark of sufficient size for the construction of canoes." The first indication of its presence that attracts the eye is the roughened surface of the bark, especially near the ground. On closer examination, it is possible to find very delicate, glassy filaments projecting from cavities in the bark. These are waxy in nature and protrude from about the caudal extremity of the coccid. Very little time was available to search for these interesting insects, but they were seen to be quite plentiful at Pictured Rocks, on a few isolated trees.

FALL ARMY-WORM.

(*Laphygma frugiperda*, S. & A.)

A curious change of habit, which, it is hoped, will not prove more than temporary, was observed in this species. Ordinarily the fall army-worm works like a fall cut-worm, feeding on many different crops and on some uncultivated plants. This year, however, it attacked the corn crop in large numbers, entering the ear and burrowing into the kernels both when they were in the milk and later, just as is done by the regular corn-worm (*Heliothus armiger*). The corn at the Station grounds was badly affected. Specimens were obtained for rearing purposes and placed in cages in the laboratory. From this material a single moth emerged on October 25, the larvæ having been received fresh from Mr. Geismar on September 10. This moth, together with a pair of larvæ, was sent to Professor J. B. Smith, of the New Jersey Experiment Station, who kindly determined it for me as *Laphygma frugiperda*.

REMEDIES.

In regard to remedial measures, Dr. J. B. Smith says:† "There are always two and sometimes three or more broods in the course of the year, and in favorable seasons these become successively more numerous, so that the late fall brood proves the most troublesome. These favorable seasons, however, do not often occur, particularly in the Eastern United States, and here climatic influences or other natural conditions reach the insects during the winter, so that in the spring following only a normal number survive. Cultivating the land in crops which admit of fall plowing is best adapted to avoid injury, and a frequent rotation will prevent them from becoming numerous enough to be destructive at any time."

*Bulletin 18, New Series, Dept. of Agriculture, Division of Entomology.
†Economic Entomology, p. 297.

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THE WHITE-MARKED TUSSOCK-MOTH.

(*Notolophus leucostigma*, S. & A.)

Familiar objects to many of us are the larvæ of caterpillars of this insect, which are about one and one-half inches long, yellow and black striped longitudinally. The head, prothoracic shield and two spots on the backs of the sixth and seventh segments are bright sealing-wax red. From each side of the first segment behind the head projects a tuft of long black hairs, forming a V-shaped fork half an inch long, which points and opens forward. From the back of the eighth segment projects backward a single similar tuft of long hairs, and on the backs of each of the first four abdominal segments is a brush-like tuft of cream-colored short hairs. Beside these there are numerous yellow hairs on the sides of the body. These brightly colored caterpillars are not at all particular in regard to their food; almost any shade or fruit tree answering the purpose. They feed alike upon apple, pear, plum, cherry, maple, elm, poplar and a large number of other trees.

When full grown the larva spins a cocoon, usually upon the tree itself, partly protected by some roughness in the bark, or else nearby on adjacent objects, usually more or less exposed. The adults of this insect are notable because the sexes are very different. The males are very pretty moths or "millers," which are provided with wings and which fly with ease. The females, on the other hand, have no wings, but are quite large and swollen creatures, capable only of laying eggs. The female comes forth from the cocoon, awaits the coming of the male, and then lays her eggs upon the empty cocoon, in a frothy mass that dries down, forming a friable, spongy covering, pure white in color unless discolored by the elements. The winter is passed in this stage, and early in the spring the eggs hatch, each giving forth a young caterpillar.

There are two broods and possibly more South, but it is not possible now to say whether there are one or two broods in upper Michigan. On August 29, an adult female on a freshly laid mass of eggs was found at Au Train Falls.

The damage done to the shade trees in a city or park is sometimes very serious. Detroit has been for some time the scene of an attack. Like the canker-worm, when the insect appears it usually comes to stay, and vigorous measures are required to overcome it.

REMEDIES.

The amount of labor and money that it will be found expedient to use in a given case will depend largely upon the circumstances. In cities it will be found possible to do much more than in hamlets or villages, while in isolated farms still less will be thought profitable, except in cases where orchards are infested. The eggs being laid in masses, sometimes 500 of them in a single bunch, and these masses being conspicuous and not well hidden, it will be found profitable to collect all egg-masses on the old cocoons during the winter season, that is, late in the fall and early in spring, or whenever they are accessible. This has been done cheaply by school children in cities for a small remuneration. The caterpillars can be killed by a thorough spray of paris-green, but tall shade trees are very difficult to treat in this way.

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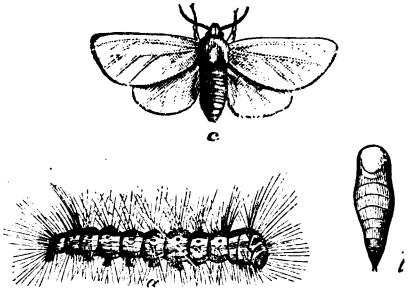
The usual way of overcoming this difficulty is to build a tall stage on a wagon and to spray from this stage, using long bamboo rods with a nozzle at one end and connected at the other end with the hose. Another method which is preventive is to band such trees as are not infested, with a strip of cotton batting. The eggs being laid on the old cocoon, fresh trees will be infested by caterpillars crawling to them, and in no other way. A band of loose cotton batting, renewed from time to time as it loses its fluffiness from rain, will entangle the larvæ as they try to climb into the tree.

THE FALL WEB-WORM.

(*Hyphantria cunea,* Dru.)

Early in autumn or late in summer the large nests or webs of this caterpillar are seen in the branches of many fruit and shade trees.

Unlike the apple-tree tent-caterpillars, which work in our apple trees in the springtime, the larvæ of this species build a web as far as they work. Both live in colonies, but the spring tent-caterpillar builds a small tent, from which the larvae go out to feed and to which they return. The fall web-worm, on the other hand, extends the nest as it becomes necessary in order to accommodate the growth of the colony. The colony is the result of a cluster of eggs laid by a single moth, usually on a leaf. The caterpillars of this insect are hairy fellows, a



Fall web-worm (*Hyphantria cunea*), from C. V. Riley, Insects of Missouri, 3d Rep.

little less than two inches in length. There is one brood a year in the North, though further south it is said that there are more. The caterpillars are light in color, yellowish, with a darker stripe on the back. When full grown they are covered with long whitish hairs. It has been said that the web is extended as the size of the colony increases. This goes on until the larvæ are very nearly full grown, when they leave the shelter and seek convenient retreats for spinning up in cocoons. This is done in almost any sheltered place, under bark or rubbish, or under the surface of the soil. The moth that comes from the cocoon measures about one and one-fourth inches from tip to tip of its extended wings. It is usually pure white, though many specimens have dark spots on the wings. The insect feeds on one hundred and twenty species of shrubs and ornamental trees,* and the damage done is often very serious. Specimens were collected on wild cherry at Chatham on August 28, 1900. A specimen of the female moth and an egg-cluster just laid were sent by Mr. Geismar on July 12.

*Dr. L. O. Howard, Year-book, Dept. of Agr. for 1895, p. 376.

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REMEDIES.

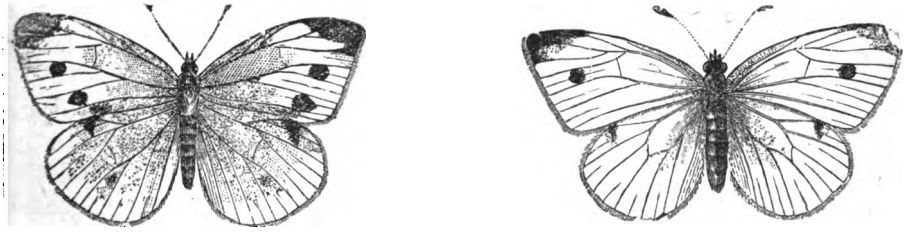
The cocoons may be collected in the winter time whenever that is feasible. Spraying the affected trees with one of the arsenites is another remedy that is often found useful. The best remedy, however, after the larvæ have obtained a start, is to apply a torch to the nest and burn them out. A bundle of oil-soaked rags or sponges tied to a long pole, or a porous brick attached in the same way, answers the purpose perfectly. With this the nest may be entirely demolished and the occupants singed without doing more than slight damage to the tree, if care is taken to move the torch quickly. Of course, the earlier this is done the better.

CABBAGE-WORMS.

(Pieris oleracea, Pieris rapæ, and *Pontia protodice.)*

All three of the cabbage butterflies were present at Chatham. We have in this country three different species or kinds of cabbage butterflies; two are native and one is introduced from Europe. Of the native species, one, *Pieris oleracea*, is pure white, the spring brood having the veins marked with grey scales on the under side of the wings. This is the native form originally found in the northern part of the United States. The larva feeds on a variety of plants, though it takes quite readily to cabbage. The species is now comparatively rare in most places, though quite common at Chatham.

The southern native species (*Pontia protodice*) is white, with a number of black checkered marks on the wings, the female having much more of the black than the male. The larva of this butterfly feeds on cabbage, rape, and a number of other plants.



Imported Cabbage Butterfly (*Pieris rapæ*), from Riley, Insects of Missouri, 2nd Rep.

The worst of all three, however, is the imported cabbage-butterfly (*Pieris rapæ*). This is white, with the tips of the front wings black. The female has two black spots on the front wings; in the male there is only one. Of all the butterflies that are injurious to crops in America this is undoubtedly the worst. The larvæ work in cabbages, rape, rutabagas and various other plants. From the nature of the case, poison cannot safely be used, and we have to resort to other means for destroying them. One of these is hot water. This has proven successful in certain cases, though complaints have come from some parties who have used it. The efficacy of hot water depends upon the fact that it takes a less degree of heat to kill cabbage-worms than it does to injure the cabbage.

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The ordinary manner of applying the hot water is through a sprinkler. Water is taken, boiling hot, to the field and poured into a sprinkler. From this it is poured on the infested plants, killing the worms, but not injuring the cabbages. Now the exact distance that must be maintained between the watering-pot and the plants cannot be stated, because the watering-pots vary so much as to the size of the holes, and the temperature is likely to vary with the distance from the heating apparatus. The finer the holes, of course, the nearer one can get to the plants. If, on the other hand, the holes in the sprinkler are coarse, the drops of water will not cool sufficiently and the plants will be injured. Everyone must try for himself on a few plants at first, and then wait to see the effect.

Another remedy that is on some accounts better is kerosene emulsion applied in the ordinary way. Professor Hillman, of the Nevada Experiment Station, highly recommends the addition of one ounce of Pyrethrum or Persian insect-powder to the liquid when it is ready to apply. The writer has tried an emulsion of the kerosene extract of Pyrethrum, which amounts to the same thing, and found it very effective against many resistant insects.

The work against the early broods of these insects in spring and early summer should be prosecuted with great vigor. At this time, before the head begins to form, the most effective work can be done.

MOSQUITOES.

(*Culex pungens*, Wied.)

During the latter part of August, at the time when the writer was at the Sub- station, mosquitoes were not very abundant. It is said that earlier in the season they are more numerous. Land that is being cleared furnishes an ideal place for them to breed. Holes made by removing stumps and into which water has settled are often fairly alive with the wrigglers. The writer collected a large number of the larvæ and pupæ from a hole which would hold little more than a pail-full of water, and bred the adults from them. They proved to be *Culex pungens* in this case. No other species were collected. No specimens of *Anopheles*, the malaria transmitting genus were seen, although especial care was taken to look for them.

The control of mosquitoes in such places is so easily maintained that it seems a pity that nothing is attempted in this direction. Dr. L. O. Howard has pointed out, time and again, that a few teaspoonfuls of kerosene will kill all the immature mosquitoes or wrigglers in a small pool, as well as many of the adults when they come to lay their eggs. In swampy places this method is more difficult to carry out, but in good, high ground, with swift water, such as is so common here, there are so few pools of any size that almost all of them could easily be treated twice a month, and the mosquito nuisance materially abated thereby. Everyone is familiar with the way that oil spreads over water, and it needs but a moment's consideration to see how kerosene, so deadly to all insect life, will kill any aquatic insects as they come to the surface to breathe. Dr. Howard recommends an ounce of the oil to fifteen square feet of water surface, and he says that the treatment need not be repeated for a month.

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NO-SEE-UM.

(Ceratopogon sp.)

Specimens of no-see-um were collected, although they were almost entirely gone by the latter end of August. They proved to be *Ceratopogon* and very closely related to, if not identical with, the "Punkie" of the Adirondacks. This insect is a very minute fly that bites.

THE POTATO-BEETLE TACHINID.

(Phorocera doryphoræ, Riley.)

As early as 1869 this fly was found to be parasitic in potato-beetles. Dr. Riley described the fly, in his first report, under the name of *Lydella doryphoræ*.*

This beneficial insect is a fly somewhat resembling a house-fly, except that the back of the abdomen has silvery spots on it and that the face is silvery white. In size it is a very little larger than the house-fly. This fly lays its eggs on the bodies of potato-beetle larvæ as well as on the adults. The egg laid on the larva hatches out and a small grub bores into its host, feeding on the living flesh and the juices of the body, but avoiding the vital parts. After the maggot has become full grown in its living host, and after the larva of the beetle has descended into the ground to pupate, the maggot changes to a puparium, corresponding to the cocoon stage of some insects. From this puparium issues another fly similar to the one which originally laid the egg. This goes on a number of times in a season, each generation of the flies destroying a number of potato-bug larvæ.

Potato Beetle with eggs of Tachina Fly (Phorocera doryphorae), original.

Specimens of the potato-bug larvæ, with eggs of the fly on them, were sent the writer by Mr. Geismar, and were placed in suitable cages in order to watch the transformations. The larvæ went into the ground just as they should, but only one fly has, as yet, come forth. It is possible that more will emerge next spring. The process of depositing the egg is described in a letter by Mr. Geismar, who says: "I noticed a fly walking around a beetle in a peculiar way, touching it from time to time. As soon as the beetle appeared dormant the fly

*Riley 1st Rep. Insects of Mo., p. 111, 1869.

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commenced to lay its eggs on top of the beetle, always keeping its head toward it and circling around it once or twice. The fly, to lay its egg in that position, passes the appendage under its body and head and raising it somewhat above its head drops an egg on the top of the beetle."

A number of adult beetles, each bearing from one to sixteen eggs, were placed in a cage with food, in hopes that the larvae might work on them. These beetles lived from July 12 until August 21, at which time the writer went away and no more observations were taken. No signs of attack, however, by the parasites were to be seen. Most of the eggs dropped off one at a time.

An attempt was made to introduce the flies here, in order to get them to work on our potato-beetles, but as no fresh flies emerged, it was impossible. A little later in the season four flies, which the writer is unable to distinguish from the potato-beetle parasite, were bred from cut-worms. The cut-worms were the last two of a large number of rapidly disappearing depredators in a field of oats and peas. They cut the oat stems into sections several inches long and also cut the pea vines. The larvæ were brought in on August 1 and the flies emerged on August 8. This would seem to indicate that the parasite in question has more than one host.

The writer was asked several times during his stay in Alger county why it was that the potato-beetles were so few in that region during the summer just passed. It is not at all unlikely their attacks were materially reduced by this parasite.

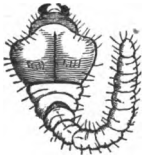
WHEAT-HEAD FLY.

(*Meromyza americana,* Fitch.)

Specimens of rye, having the heads bleached out to a dry, straw-color, while the leaves and stem below the upper joint were apparently healthy, were sent by Mr. Geismar on July 10. They were placed in a cage, and on August 2, the adults emerged. The larva of this fly works just above the top joint in rye, wheat and some grasses, eating out the succulent base of the stem at this point. The only remedial measure yet known is the rotation of crops.

THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata,* Fab.)



Flat-headed Apple-tree Borer (*Chrysobothris femorata*), from C. V. Riley, Insects of Missouri, 2nd Rep.

This insect bores into the trunks and larger limbs of apple trees, doing very great damage. It is the worst borer of the apple, while it

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vorks also in oak, peach, soft maple, weeping willow, mountain ash, ox-elder, pear, linden, beech and cherry.

The eggs are said to be laid on the bark in June and during the fore art of July. The larvæ work at first in the sap-wood, making cavities etween the bark and the wood, ejecting their excrement through mall openings in the bark. Late in the summer or early in the fall hey penetrate into the solid heart-wood to pass the winter, ceasing at his time to eject castings, instead, packing their waste in the cavities ust vacated. It takes two or three years for them to become perfect, vinged insects. The larva that does all this damage is white and soft, nprotected otherwise than by its habitation. The front end of the ody, or the thorax, is very broad and oval and the head small. The oles bored by this insect are not round, but oval in section, fitting the orm of the thorax.

REMEDIES.

Now, borers are difficult things to fight under all circumstances, and o course of treatment is known which will entirely eradicate them. Nevertheless, every one that is killed is just so much gained for the eneral good. There are three practices that have been found useful, hough no one of them or all of them combined will rid an orchard f an insect that breeds in so many host trees. They are the same old emedies recommended by Dr. Fitch many years ago and which have ot since been improved upon.

They consist in protecting by means of a wash, binding the trunk with aper, and digging out the young larvæ.

Whitewash or whitewash and glue, applied to the trunk and large imbs is said to have a very beneficial effect. It should be applied early n June, and kept on in good condition through most of July. Soft oap is also used for this purpose.

Second, binding paper about the trunk and larger limbs. For this urpose newspaper is best used next the tree and building paper outide.

Third, searching for the young larvæ during August and September. t this time the young have not gone into the sap-wood, but live in avities just under the bark, the excrement being pushed out through mall holes. When any suspicious waste is seen protruding from the ark, it is well to investigate with a stiff pin, and if a cavity is found, o extract the occupant before he goes so deeply into the wood as to e beyond our reach. A little time spent each fall in this way will be vell repaid by increased vigor of our orchards.

THE CHERRY LEAF-BEETLE.

(*Galerucella cavicollis*, Lec.)

The cherry leaf-beetle is an interesting species, because of its known hange of habit. It ordinarily feeds on pin cherry and was found in umbers on that host-plant at Au Train Falls. At least twice it has ttacked the cultivated cherry in Michigan, each time doing appreci-

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Cherry Leaf Beetle (*Galerucella cavicollis*), from author's Bulletin 160.

able injury. Mr. G. C. Davis mentions it in the Report of the Michigan Board of Agriculture for 1894, as occurring at Bellaire, and the writer has noticed it once in bulletin 160, as being injurious in 1897. At that time it was at Traverse City on June 8. The beetle readily responds to a spray of paris-green whenever it becomes troublesome.

LIST OF MOLLUSCS DETERMINED BY MR. BRYANT WALKER.

Limax campestris, *Say.*, Munising.
Vitrea rhodesi, *Pils.*, Munising Junction.
Vitrea indentata, *Say.*, Chatham.
Vertigo gouldii, *Binn.*, Munising Junction.
Conulus fulvus, *Dr.*, Munising Junction.
Zonitoides arboreus, *Say.*, Munising Junction, Chatham.
Pryamidula alternata, *Say.*, Beaver Island, Munising Junction.
Pyramidula striatella, *Anth.*, Munising Junction, Chatham.
Polygera albolabris, *Say.*, Beaver Island, Au Train Falls.
Polygera albolabris *var.* maritima, *Pils.*, Chatham.
Polygera monodon, *Rack.*, Munising, Munising Junction, Beaver Island.
Strobilops virgo, *Pils.*, Munising Junction.
Limnea catascopium, *Say.*, Beaver Island.
Limnea humilis, *Say.*, Beaver Island.
Limnea lancelata, *Gld.*, (?) Beaver Island.
Limnea sayii, *Tap.*, Beaver Island.
Limnea gyrina, *Say.*, Chatham, Munising Junction, Beaver Island.
Limnea ancillaria, *Say.*, Beaver Island.
Limnea ancillaria *var.* lacustris, *Walk.*, Beaver Island.
Limnea integra, *Hald.*, Beaver Island, Au Train Falls, Chatham.
Planorbis trivolvus, *Say.*, Beaver Island.
Valvata tricarinata, *Say.*, Beaver Island.
Valvata tricarinata *var.* bicarinata, *Lea.*, Beaver Island.
Campeloma decisa, *Say.*, Beaver Island.
Campeloma integra, *Say.*, Beaver Island.
Amnicola limosa, *Say.*, Beaver Island.
Amnicola lustrica, *Pils.*, Beaver Island.

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Goniabasis livescens, *Mke.*, Beaver Island, Petoskey, Au Train Falls.
Unio luteolus, *Lam.*, Beaver Island.
Anodonta fragilis, *Lam.*, Beaver Island.
Anodonta footiana, *Lea.*. Beaver Island.
Sphaerium striatinum, *Lam.*, Beaver Island.
Pisidium virginicum, *Bgt.*, Beaver Island.
Pisidium compressum, *Prm.*, Beaver Island,
Pisidium scutellatum, *St.*, Beaver Island.
Pisidium sp., Beaver Island.

LIST OF ARACHNIDAE DETERMINED BY MR. NATHAN BANKS.

Epeira domiciliorum, *Htz.*, Chatham, August 23, 1900.
Amaurobius bennetti, *Blk.*, Chatham, September 1, Munising, 27 Aug., September 3, Munising Junction.
Philaeus militaris, *Htz.*, Chatham, August 23.
Pardosa sp. (young) Chatham, August 23 .
Epeira trifolium, *Htz.*, Chatham, August 25.
Epeira insularis, *Htz.*, Beaver Island, September 6.
Epeira trivitta, *Keys.*, Beaver Island, September 6 and 8.
Tetragnathus extensa, *Linn.*, Beaver Island, September 6.
Otiogolophus pictus, *Wood.*, Beaver Island, September 6.
Phalangium cinerium, *Wood.*, Beaver Island, September 6.
Liburnum dorsatum, *S.*, Beaver Island, September 8.
Phlegmacera cavicoleus, *Pack.*, Beaver Island, September 8.
Misumena rosea, *Keys.*, Beaver Island, September 8.

PARTIAL LIST OF INSECTS COLLECTED IN ALGER COUNTY.

Order Odonata:
Aeschna verticalis, *Hag.*, Chatham, August 22, 1900.
Diplax rubicundula, *Say.*, Chatham, August 28.
Diplax vicina, *Hag.*, Munising Junction, September 3.
Order Euplexoptera:
Labia minor, *Linn.*, Chatham, August 22.
Order Orthoptera:
Dissosteira carolina, *Linn.*, Munising Junction, September 3.
Camnula pellucida, *Scud.*, Chatham, August 27.
*Circotettix verriculatus, *Kirby*, Chatham, August 22.
Melanoplus femoratus, *Burm.*, Chatham, August 28.
Melanoplus atlanis, *Riley*, Chatham, August 22.
Tettix sp., (nymph), Chatham, August 28.
Tettix granulatus, *Kirb.*, Chatham, July 12 and August 8 (Crosby).
Ceuthophilus sp., Munising Junction, September 3.
Scudderia curvicauda, *De G.*, Munising Junction, August 22 and 28,
Xiphidium fasciatum, *De G.*, Munising, September 3.
Gryllus luctuosus, *Serv.*, Au Train Falls, August 29.
Nemobius fasciatus, *De G.*, Au Train Falls, August 29.
Order Hemiptera (Heteroptera):
Notonecta undulata, *Say.*, Munising Junction, September 3.
Salda. sp., Au Train Falls, August 29.

*Determined by Prof. W. S. Blatchley.

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Rhagovelia sp., Au Train Falls, August 29.
Hygrotrechus sp., Chatham, August 28.
Limnoporus sp., Chatham, August 28.
Limnoporus sp., Munising Junction, September 3.
Sinea spinapes, *H. Schaf.*, Chatham, September 3.
Coriscus sp., Chatham, September 1.
Aradus sp., Munising Junction, September 3.
Acanthia lectularia, *Linn.*, Chatham, August 28.
Poecilocapsus goniophorus, *Say.*, Chatham, August 22.
Poecilocapsus lineatus, *Fab.*, Chatham, July 5 (Crosby).
Lygus pratensis, *Linn.*, Chatham, August 23.
Pediculis vestimenti, *Leach*, Chatham, September 1 (Crosby).

Order Hemiptera (Homoptera):
Aphrophora sp., Chatham, August 22.
Ceresa diceros, *Say.*, Chatham, August 22.
Ceresa sp., Chatham, August 22.
Schizoneura tesselata, *Fitch*, Munising, August 26.
Xylococcus betulæ, *Hub.* and *Schw.*, Pictured Rocks, August 26.

Order Neuroptera:
Chrysopa rufilabris, *Burm.*, Beaver Island, September 5.
Chrysopa oculata, *Say.*, Chatham, August 23.
Polystoechotes punctatus, *Fab.*, Chatham, August 23.

Order Trichoptera:
Neuronia semifasciata, *Say.*, Chatham, August 23.
Oecetina incerta, *Walk.*, Chatham, August 23.
Triaenodes ignita, *Walk.*, Chatham, August 23.
Heliopsyche sp. (larva), Au Train Falls, August 29.
Platyphylax sp., Chatham, August 23.

Order Lepidoptera:
Incurvaria acerifoliella, *Fitch.*, Chatham, August 22.
Sesia sp., Chatham, August 23.
Microgonia limbaria, *Haw.*, (Nematocampa), Chatham, June 26.
Haematopis grataria, *Fabr.*, Chatham, August 24.
Ochyria designata, *Hbn.*, Chatham, August 23.
Oreta rosea, *Walk.*, Chatham (Crosby).
Plusia balluca, *Geyer*, Chatham, August 6 (Crosby).
Plusia sp., Chatham, August 4 (Crosby).
Feltia subgothica, *Steph.*, Munising, August 26.
Laphygma frugiperda, *S.* and *A.* (larva), Chatham, September 1.
Catocala relicta, *Walk.*, Chatham, August 28.
Catocala sp., Chatham, July 12 (Crosby).
Notolophus leucostigma, *S.* and *A.*, Au Train Falls, August 29.
Notolophus antiqua (larva), Chatham, June 22 (Geismar).
Hythantria cunea, *Dru.*, Chatham, August 28.
Nemophila noctuella, *S. V.*, Munising, August 26.
Pontia protodice, *Boisd. Le C.*, Chatham, August 23.
Pieris oleracea, *Harr.*, Chatham, August 23.
Pieris rapae, *Linn.*, Chatham, August 23.
Eurymus erytheme, *Boisd.*, Chatham, September 3.
Eurymus philodice, *God.*, Chatham, September 1.
Heodes hypophleus, *Boisd.*, Chatham, August 22.
Anosia plexhippus, *Linn.*, Chatham, August 22.

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Argynnis cybele, *Fabr.*, Chatham, August 22.
Brenthis myrina, *Cram.*, Chatham, August 22.
Vanessa huntera, *Fabr.*, Chatham, August 22.
Vanessa atalanta, *Linn.*, Chatham, August 23.
Aglais milberti, *God.*, Chatham, August 22, Au Train Falls, August 29.
Euvanessa antiopa, *Linn.*, Chatham, August 24.
Polygonia comma, *Harr.*, Chatham, August 28.
Polygonia prognae, *Cram.*, Chatham, August 23, and Munising Junction, 3 Sept.

Order Diptera:
Pachyrrhina ferruginea, Chatham, August 22.
Pedicia albivitta, *Walk.*, Chatham, August 22.
Limnobia cinctipes, *Say.*, Chatham, August 22.
Culex pungens, *Wied.* (bred), Chatham. August 29.
Ceratopogon sp., Munising, August 26.
Cecidomyia strobiloides, *Walsh*, Munising. August 26.
Plecia heteroptera, *Say.*, Munising Junction, September 3.
Bibio sp., Chatham, August 28.
Tabanus sp., Munising, August 26.
Tabanus sp., Chatham, September 1.
Tabanus lasiopthalmus, *Macq.*, Chatham, July 6 (Crosby).
Chrysops univittatus, *Macq.*, Chatham, August 25.
Syrphus americanus, *Wied.*, Chatham, August 23.
Musca domestica, *Linn.*, Chatham, August 29.
Phorocera doryphoræ, *Riley*, Chatham, July 9 (Geis.)
Juonia apicifera (?) *Walk.*, Chatham, August 22.
Juonia sp., Chatham, August 23.
Meromyza americana, *Fitch.*, Chatham, July 17 (Geis.)

Order Siphonaptera:
Pulex irritans, *Linn.*, Chatham, August 28, 1900.

Order Coleoptera:
Cicindela vulgaris, *Say.*, Chatham, August 28.
Cicindela 12-guttata, *Deg.*, Chatham, August 28.
Chlaenius sericeus, *Forst.*, Chatham, August 7 (Crosby).
Harpalus caliginosus, *Fab.*, Chatham, August 28.
Elaphrus sp., Chatham, August 28.
Acilius sp., Chatham, August 28.
Silpha noveboracensis, *Forst.*, Chatham, August 6 (Crosby).
Silpha lapponica, *Hbst.*, Chatham, August 6 (Crosby).
Coccinella transverso-guttata, *Fab.*, Chatham, August 28.
Coccinella 9-notata, *Hbst.*, Chatham, August 22.
Coccinella trifasciata, *Linn.*, Au Train Falls, August 29.
Coccinella sanguinea, *Linn.*, Chatham, August 28.
Hippodamia 13-punctata, *Linn.*, Chatham, July 12 (Crosby).
Hyperaspis bigeminata, *Rand.*, Chatham, September 1.
Cucujus clavipes, *Fab.*, Munising Junction, August 21.
Ips fasciatus, *Oliv.*, Chatham, September 1.
Dicerca divaricata, *Say.*, Chatham, July 7 (Crosby).
Buprestis fasciata, *Fab.*, Chatham, August 28.
Melanophila longipes, *Say.*, Chatham, August 21.
Chrysobothris femorata, *Fab.*, Chatham, July 7 (Crosby).

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Calopteron terminale, *Say.*, Chatham, August 28.
Platerus sp., Chatham, September 3.
Geotrupes sp., Chatham, September 1.
Trichodes nuttalli, *Kirb.*, Chatham, July 14 (Crosby).
Euphoria inda, *Linn.*, Chatham (Crosby).
Trichius affinis, *Gorg.*, Chatham, July 5 (Crosby).
Clytanthus ruricola, *Oliv.*, Chatham (Crosby).
Bellamira scalaris, *Say.*, Chatham, August 4 (Crosby).
Leptura canadensis, *Fab.*, Chatham, July 7 (Crosby).
Leptura proxima, *Say.*, Chatham (Crosby).
Leptura sp., Chatham, July 7 (Crosby).
Monohammus confusor, *Kirb.*, Chatham (Crosby).
Monohammus sp., Chatham, July 14 (Crosby).
Saperda vestita, *Say.*, Chatham, August 28.
Chrysochus auratus, *Fab.*, Chatham (Crosby).
Galerucella cavicollis, *Le C.*, Au Train Falls, August 29.
Diabrotica-12 punctata, *Oliv.*, Chatham, August 28.
Phellopsis porcata, *Lee*, Munising Junction, August 21.
Nyctobates pennsylvanica, *De G.*, Chatham, August 28.
Upis cerambycoides, *Linn.*, Chatham, August 28.
Boletotherus bifurcus, *Fab.*, Munising Junction, August 21.
Meloë sp., Chatham (Crosby).
Dendroctonus terebrans, *Oliv.*, Munising, August 26.
Catoparis lunatus, *Fab.*, Chatham, September 1.

Order Hymenoptera:

Tremex columba, *Linn.*, Chatham, August 28.
Sirex sp., Chatham, August 22.
Ichneumon grandis, *Brul.*, Chatham, August 22.
Thalessa lunator, *Fabr.*, Chatham, August 22.
Ophion sp., Munising, August 26.
Odynerus sp., Chatham, August 23.
Vespa diabolica, *Sauss.*, Chatham, August 22.
Bombus pennsylvanica, *De G.*, Chatham, August 28.
Bombus praticola, *Kirby*, Chatham, August 23, and Munising, August 26.
Bombus sp., Chatham, August 22.

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SOILS OF THE UPPER PENINSULA.

BY A. C. LANE, STATE GEOLOGIST.

It is not easy to say very much of value regarding the soils of the Upper Peninsula in a few words, because, with some exceptions, they are confined to rather small areas. One noticeable character of the Upper Peninsula, as compared with the Lower, is the relative shallowness of the soils and sub-soils, so that exposures of bed rock are much more frequent, though there are places where the surface deposits are much over 100 feet thick. The Great Lakes were at one time higher than at present—some 600 feet higher on Keweenaw Point, and from that varying down to 200 or 300 feet around Menominee. Consequently, except as modified by the cutting of the streams below the level mentioned, the soils are arranged in long lines, parallel roughly to the shore, and consisting of strips which are sandy and gravelly, backed with marshes alternating with clay. The sand or gravel deposits mark the old beach lines of permanent level, and the clay the levels from which the water retired very rapidly. It may be expected that the higher levels would be somewhat more gravelly than the lower, which consist of rehandled material, but this is liable to many exceptions where the shore cuts into bed rock. In many cases this old beach line has been piled up into dunes, which travel back from the shore in line after line, between which are narrow swamps with a soil of muck, shells and clay. Above the highest level of the lakes, where the lake deposits have been removed, we expect to find some deposits of glacial dump soils, known as till, or overwashed sands or gravels deposited by the waters of the melting ice, or clays deposited in lakes dammed by the ice. We find, however, that a very large part of the highlands have been washed and burnt bare, the most conspicuous exception being certain parts of the Copper Range, upon the summit of which are piled overwashed deposits of sand and gravel, full of kettle holes and lakes. These glacial deposits may be also exposed by erosion at lower levels, and as a matter of fact we find in a great many places a very fine-grained pink clay, which often lies under a coarser deposit of sand, gravel or clay. These clays of the Upper Peninsula are generally somewhat calcareous, and in Part I of Vol. 8 of our reports, just issued, will be found four or five analyses. They also contain quite a little iron, which is natural when we consider that they come from the region of iron-bearing rocks. The cold and damp climate favors the growth of peat moss, and we find very extensive deposits along the Upper Taquamenon and Manistique rivers, and small deposits will be found elsewhere.

The celery of Newberry bids fair to rival in character that of Kalamazoo, and about the southeastern part of the peninsula, where the

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sub-soil is limestone and the waters limy and marl in the lakes not infrequent, it is probable that there will be little difficulty with the souring of this soil.

The ice moved in a general way parallel to the course of the lakes, and hence more from the east than in the Lower Peninsula, and in the region of the sedimentary rocks which lie east of the line from Marquette to Menominee, the course of the underlying bed rock runs very much the same, so that the vast bulk of the materials of the soils comes from the underlying lakes. Consequently in the northern part, following the outcrops of sandstone shown on our map of the Upper Peninsula, the soil is prevailingly sandy, and the rehandling by the ice of Lake Superior has only served to make it more so. On the other hand, as we approach Lake Michigan we get into the belt of the Trenton limestone and the Cincinnati beds, and the very same formations which make the famous and fertile "blue grass" region of Kentucky.

This formation contains a great many fossils and brachipoids with phosphatic shells, and I know of no reason why they should uot be as good soils as in Kentucky, of course leaving out of account the difference in climate. And south of these and the beds of the overlying Niagara limestone in the Helderberg, we may find good beds of gypsum, which furnish an excellent soil. The Upper Peninsula Experiment Station, Chatham, lies toward the north margin of the limestone belts, and the excellent farms and fruit around Menominee show in a practical way the good quality of the land. Of course, we have the sandy strips already mentioned, and there are many small lakes, often without outlets, but the sand is rarely too deep for orchards. When we come to the iron country in Marquette, Baraga, Iron, Dickinson and Gogebic counties, we are in a region where now-a-days fire has generally swept more than once. The hills are washed bare of soil and usually rise without much regularity in smooth, round knobs, while between these are streams, which were often dammed by the beavers into a succession of beaver meadows. Two or three Iron county clays will be found analyzed in our paper on "Clays and Shales," by Professor Ries.

Beyond the iron country we come into a long trough, which forms an extension to Keweenaw Bay, and extends a little west of Gogebic Lake. This is underlain by sandstone and the soil is generally sandy, and it was at one time covered with a dense growth of pine. I think the finest view of pine I have ever seen was in the drive from Norwich mine to Matchwood, where the road runs as through colonnades of an endless cathedral. On the north side of this area, which also extends up the east side of Keweenaw Point to Lac La Belle, lies the Copper Range. This is in general covered with a heavy growth of sugar maple, though on the top, where are the overwashed sand and gravel of the ice age, there has been not a little pine and hemlock, and this growth of hardwood indicates the good character of the soil, which is somewhat more clayey.

The basic rocks of which the Copper Range is mainly composed, weather down into an impure red clay, and as the rocks themselves contain a relatively large per cent of phosphorus and soda, it may be

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expected that the clays will be fertile. Such has been the experience in other regions as to clays which come from the disintegration of such rocks.

I should, perhaps, mention in regard to this sandy region south of the Copper Range, that analyses of the underlying sandstone show relatively high per cent of feldspar, amounting in some cases to one-third of the rock, so that the sandy soils derived therefrom should have, therefore, a good per cent of potash, which would be slowly yielded by decomposition, to the permanent enrichment of the soils.

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